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Municipal Engineering

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QUALIFICATIONS OF ENGINEERS

The governor of Pennsylvania appointed a commission of engineers some three years ago, according to instructions from the legislature, to investigate the question of the regulation of the practice of engineering. The report of the commission, just issued, has worked out the detail of the application of the principal for which this department of MUNICIPAL ENGINEERING has argued for many years. The recommendation is that the qualifications of engineers wishing employment in subordinate positions on public work be determined by examinations and otherwise, and that eligible lists be provided as the result of such examinations, from which engineers shall be selected for public employment. Consulting engineers and experts are to have their qualifications passed upon by a state board without examination. The private practice of engineering is not to be interfered with.

The result of such a plan, often predicted by the writer, will be that the eligible lists for engineers of various branches and qualifications will be referred to for information about engineers for private employment, and the absence of a man's name from the lists will often be a deterrent to his employment, so that private practice will be regulated indirectly and without the objectionable features accompanying license laws for professional men.

MUNICIPAL BONDS

The popularity of municipal bonds continues, and it should be possible for cities to do much work on public improvements this year if they are willing to distribute the cost over a series of years by means of a bond issue. A good many of the smaller cities are expecting to do little this year because they do not issue bonds to pay for their improvements, and have done so much in the last year or two that they must stop to make up their deficits. In one or two sections of the country such cities expect to do but little on account of the increasing cost of materials and labor, but apparently this complaint is not widespread, and most cities report that they expect to do more work this year than last, a large proportion of them stating that they will raise the money by bond issues. Even in the cities where most of the improvements are made by assessments on the property, the deferred payments are carried by short-time bonds, for which the market is good, tho not as good as for regular city bonds.

One feature of advantage to cities is the preference for bonds a proportion of which are paid each year, so that the actual average term of the bond issue is only half that of the last bonds retired. This is the cheapest form for the cities, as shown in this department recently, and it really gives the best security to the bondholders, because as the improvements deteriorate thru use the indebtedness is diminished, so that the value behind the bonds bears always quite a direct relation to the amount of bonds outstanding. Usually there is quite a margin of value, especially if the improvements are of such a nature that repairs and renewals can be made readily and economically.

The larger cities and many of the smaller cities will take advantage of these conditions and promise now to increase materially their improvement work during 1916. Many cities, especially in the north and northeast, hold their city elections in March and April and leave it for the new city administrations to lay out the programs for the year's improvements, so that the tables and lists on other pages of this number are not complete as to these sections of the country.

COST DATA

Ordinary cost data are not of much value, because they are not accompanied by enough information about the special conditions which affect the particular job and so they must be taken with much caution if they are to be applied to any particular case. Good ideas can be obtained of the usual cost of doing work of a similar nature by collecting a sufficient number of reports from different jobs, but neither specific figures nor averages can be safely used exactly in any other case. Cost data do have their value, however, especially when there are given also as full details of conditions as are given in two or three of our articles this month, and it is worth while to study them carefully and to use them as the basis on which to make prices or estimates on a job where the effects of the local conditions can be compared.

WEST WASHINGTON STREET BRIDGE UNDER CONSTRUCTION. EXCAVATION OF NEW RIVER CHANNEL IN FOREGROUND.

FLOOD PROTECTION IN INDIANAPOLIS

The early completion of the first flood protection work in Indianapolis will put that city at the head of those suffering severely from the floods of March, 1913, in time of completion. The variety of work and the ingenuity exercised in solving the numerous special problems arising make this brief article on methods and results of particular interest. The illustrations aid in giving a clear idea of what has been done.

INDIANAPOLIS seems to be the first city which was seriously affected by the floods of March, 1913, which has constructed any large proportion of its flood protection works. The plans were made to protect, first, the large area on the west side of White River, covered with factories and small residences, on which the greatest damage was done, and which was left unprotected by the destruction of its levees. The existing laws were made use of after the legislature of 1915 failed to pass laws making the process less complicated, and the work was restricted to that which could be taken care of under the statutes.

The first two years after the flood were taken up in making surveys, plans and estimates and devising the new bills for the proposed legislation. A new and more active administration came into office with 1915 and immediately put the plans into shape for the letting of contracts, and as soon as possible passed thru the necessary legal steps to begin the work.

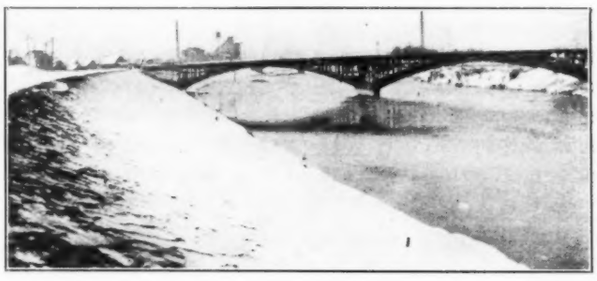
In brief, the flood protection works consist of a levee extending from the bluff at Riverside Park, at the north end of the flooded district, to the Belt Railway embankment on the south. This levee is protected by reinforced concrete walls wherever necessary, and with concrete riprap in other sections. A large part of it is wide enough to accommodate a boulevard with driveway 30 or 40 feet wide, two 15-foot lawns and one 5-foot sidewalk. In the region of the railroads, south of Washington street, the driveway leaves the levee and drops down behind it to pass under the tracks, with concrete walls on both sides. From Oliver avenue south to the south end of the Indianapolis Abattoir Company's land the levee follows the lines of River avenue and Drover street, which are elevated some 12 to 16 feet, and then turns back to the river bank. Where the levee passes the street railway plant north of Washington street it is reduced to the narrowest possible limits and still encroaches on the company's buildings. The boulevard leaves the levee a short distance above the plant and follows Bloomington street to Washington street. At the north end the boulevard turns west into Fourteenth street at Belmont avenue, near the Riverside Park dam.

The top of the levee is 4 feet above the flood height of 1913, and the channel lines of the river have been located so as to give a clear width of 650 feet and a depth of 29 feet below the high-water mark. Above Tenth street, at and for a considerable distance below Washington street and for the distance below Oliver avenue above described, the levee on the west side is set back from the old banks to straighten the stream and give the required width. Future work on the east side will be located back from the bank at other places so as to have the same effect there.

A law passed in 1915 provides that the district benefited by the levee shall pay one-tenth of the cost of land and construction and that the city and county shall each pay 45 per cent. The amount of work under the contracts was limited by the ability of the city to pay its share of the cost. The total cost is about $1,300,000, of which $500,000 is for property acquired and other expenses aside from construction. The assessment is distributed over about 1,400 acres and averages nearly $100 an acre on land worth, say, $1,000 to $5,000 an acre.

The Tenth street bridge, when it is replaced by a new bridge, will be lengthened and moved westward. The Michigan street bridge will ultimately be lengthened on the east end. The New York street bridge, shown in a photograph, is

NEW YORK STREET BRIDGE OVER WHITE RIVER. A STEEL ARCH UNDER CONSTRUCTION. NEW LEVEE IS SEEN ON LEFT PARTLY COVERED WITH SNOW. THE BOULEVARD IS ON TOP AND THE SLOPE IS READY TO RECEIVE THE CONCRETE RIP-RAP AS SOON AS THE SPRING OPENS.



a new steel structure designed to fit the new channel. The Washington street arch bridge, shown in a photograph under construction, is building and has been lengthened very materially on the west end. The railroad bridges will all be lengthened on the west end. The railroads are now building their bridges over the new boulevard subway, and will shortly proceed with the reconstruction of their river bridges. The River avenue bridge will be lengthened to the east later, and the Kentucky avenue bridge will be rebuilt at some future time to fit the new channel. The Morris street bridge needs no attention until the east side of the river is improved.

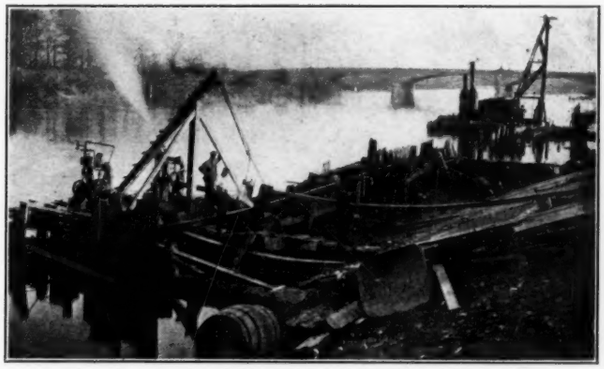
The T. A. Kearns Company, Chicago, Ill., have the subcontract for the levee from Lansing street to the north end, including the boulevard connections at both ends to the streets. This contract covers the shaping of the old bank of the river and the fill for the levee and includes about 350,000 cubic yards of embankment. On the lower part of the work the shaping of the bank was done by a steam Lidgerwood dragline scraper outfit, the 70-foot boom and 1½-yard bucket traveling along the bank and dragging the excess dirt up and depositing it in the levee. This work is all completed ready for the concrete surface protection, some of which is already in place. A photograph shows the laying of the floor of the protection on one section of the levee.

SLOPING AND FINISHING LEVEE BETWEEN BELT RAILROAD AND BELMONT AVENUE, NEAR NORTH END OF WORK. CONTRACTOR KEARN'S BIG DRAG LINE EXCAVATOR AT WORK. THE ORIGINAL GROUND FOUNDATION IS SEEN NEAR THE MACHINE, THE TOP OF THE LEVEE AT THE RIGHT AND THE FINISHED SLOPE IN THE FOREGROUND. THE EXCAVATOR TOOK MATERIAL FROM THE AREA AT THE LEFT WITH WHICH TO BUILD THE LEVEE, AS WELL AS THAT GRADED OFF THE BANK. BELT RAILROAD BRIDGE AT LEFT IN BACKGROUND.

North of the Belt railroad, Schurmann avenue, the company operated a 100-foot boom and 4½-yard bucket, excavating the material from the new channel and depositing it in the levee at the rate of 5,000 cubic yards a day. The machine was operated by electricity. It is shown in a photograph herewith.

The earth in the embankment in the lower section was hauled various distances up to two miles. Four 9-car trains of 4-yard Western dump cars were loaded by a 70-ton Bucyrus shovel and handled 35,000 cubic yards a month.

Hickey Bros., St. Louis, Mo., had the sub-contract for building the wall placed in front of the levee at the Tenth street bridge opposite the mouth of Fall Creek, where the wash of that stream is dangerous. This wall is 950 feet long, and the power house of the Terre Haute, Indianapolis & Eastern Interurban Railway is immediately behind it. They used Blaw steel forms and electric power.

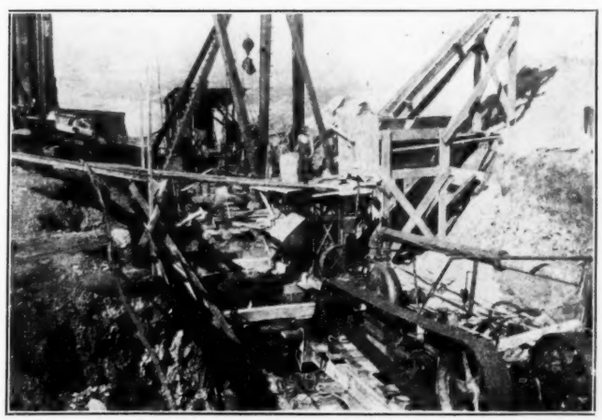


LAYING CONCRETE RIP-RAP BELOW THE WATER LINE AT TOE OF LEVEE SLOPE, UNDER PROTECTION OF COFFER DAM. MICHIGAN STREET BRIDGE IN BACKGROUND. THIS BRIDGE WILL BE LENGTHENED TOWARD THE LEFT WHEN THE EAST BANK OF THE RIVER IS IMPROVED.

The Kuert Contracting Company, Indianapolis, Ind., subcontractors, are building the wall on the concave bend below the New York street bridge and above the Washington street bridge, most of it being in front of the power plant of the city street railroad system. This wall is founded on piles driven 19.5 feet below the bottom of the excavation for the wall and projecting 18 inches above it, there being four rows of piles 18 inches apart and 12 inches apart in the rows. The concrete base of the wall surrounds the pile tops and is from 8 to 15 feet thick, and 8 feet deep. It has pockets in its upper surface to bond it with the wall above.

The wall above this base is 31.5 feet high, 12 feet thick at the bottom and 15 inches thick just under the 3-foot coping, 9 inches deep. The top of the coping is 4 feet above high

BUILDING A FORTY-FOOT SECTION OF CONCRETE FOOTING FOR RETAINING WALL IN FRONT OF STREET CAR POWER PLANT. CORNER OF CAR BARN TORN OUT TO MAKE ROOM ON THE LEFT. A-FRAME DERRICK HANDLES MATERIALS AND APPARATUS. CENTRIFUGAL PUMP IN FOREGROUND PUMPS THE WATER OUT OF THE EXCAVATION. CONCRETE MIXER IN REAR OF PUMP DISCHARGES CONCRETE INTO PLACE. MATERIAL FOR MIXER REACHES IT THROUGH THE CHUTES AND BINS AT THE RIGHT.

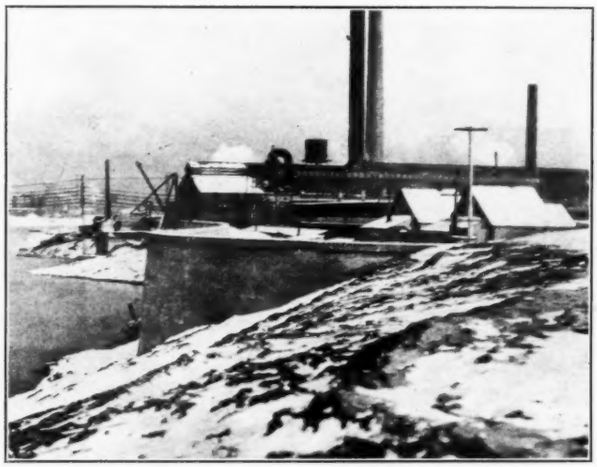


BUILDING THE CONCRETE RETAINING WALL ON THE FOOTING SHOWN IN PRECEDING PHOTOGRAPH. STEEL FRAMES FOR FORMS IN FOREGROUND, WITH COMPLETED FORMS FARTHER BACK, AND COMPLETED WALL STILL FARTHER BEYOND. NOTE THE CABLES NECESSARY TO PREVENT THE FORMS MOVING TO THE RIGHT WHEN FILLED WITH CONCRETE.

water. The batter of the wall on the river side is 1:12, and on the earth fill side is 3½:12. From the back of the foundation to a point 8 feet below the top, or about 4 feet above the former ground level, the back of the wall is waterproofed with three layers of asphalt felt put on with five moppings of asphaltic cement. There are 26,000 cubic yards of concrete in the 2,300 linear feet of this wall.

In building the wall on the pile foundation, A-frame derricks were used, mounted on a platform spanning the base, the booms being long enough to serve a 40-foot section under construction. A Vulcan steam hammer drove the 3-inch oak sheeting, which was braced with three sets of 10x10-inch wales and 12x12-inch cross-braces, one at each end and one at the center. Excavation was made with a one-yard Hayward grab bucket, a ten-inch Potts centrifugal pump driven by a straight-line Atlas engine being required to keep the water down. The outfit is shown in an accompanying photograph. Gravel excavated contained much fine sand and was used in making the concrete for the wall, the bucket delivering it direct to a screen and thence to a hopper feeding a mixer, which in turn feeds the concrete thru chute by gravity into the trench. The proportions used were 1:2½:5.

The wall above the base was built in Hydraulic Pressed Steel Company's forms, which are shown in various stages of the operation in one of the photographs. The upright and horizontal bars and clamps for holding the panel plates are clearly shown. The main vertical pieces are U-shaped, flared at the wall and with slotted keyways at the back. The panels are of wood, edged with pressed steel, and 36 inches square. Wedges driven home hold the keys in the keyholes and thus hold the clamps, which hold the panels. Wooden struts hold the forms apart until filled by the concrete, and clamps prevent spreading. Cables attached to deadmen outside held the forms, which developed a tendency to move toward the bank when filled with concrete. The sections of wall were constructed 26 feet 8 inches long and were poured in about five and one-half hours. The ribs were left in place two days before removing, but the panels were removed the next day after the concrete was poured. The forms could be moved forward and set up so that a section was poured each alternate day. The Smith mixer and Insley chute for mixing, elevating and depositing concrete, are shown in a photograph, which shows also the recess in the end of a section for bonding it with the next. Another photograph shows the curved end of the wall in front of the street railway plant where it meets the boulevard, and the reverse curve of its course. It also shows the outlets for the drainage from the power plant and the streets.



UPPER END OF CONCRETE RETAINING WALL AT STREET CAR PLANT, SHOWING CURVE TO CONNECT WALL WITH LEVEE, RIVER SLOPE OF WHICH IS IN THE FOREGROUND. REVERSE CURVE IN WALL IS SHOWN IN THE CORNER OF THE COPING. WALL CONSTRUCTION IN PROGRESS IN BACKGROUND.

VIEW OF WALL UNDER CONSTRUCTION FROM DIRECTION OPPOSITE TO THAT OF THE PRECEDING PHOTOGRAPH. COMPLETED WALL IN FOREGROUND, SHOWING RECESS IN END TO AID IN BONDING WITH THE NEXT SECTION. CONCRETE MIXER, WITH ELEVATOR TOWER AND CHUTE BUILDING WALL, FARTHER BACK. IN BACKGROUND IS OUTFIT LAYING CONCRETE FOOTING ON WHICH THE WALL IS TO BE BUILT.

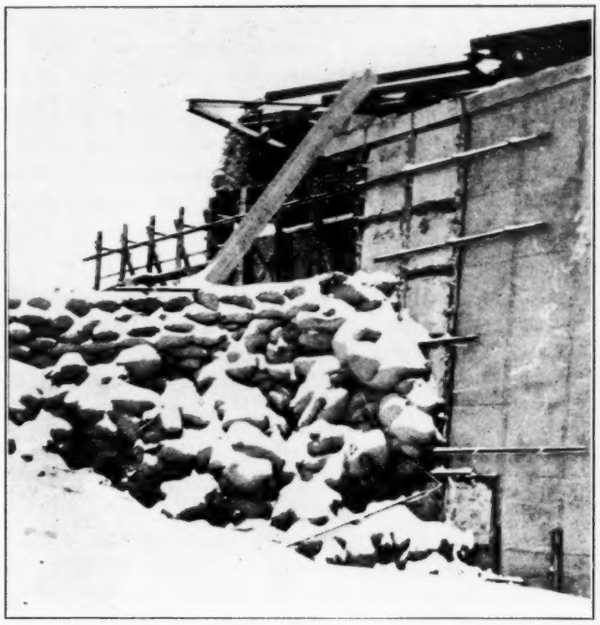
A flood in January, 1916, came when there were two openings in this wall which were not yet closed. Rapid work with teams and sand bags prevented the flood getting thru the breaks, and they will probably be out of danger before another flood arrives. One of these openings is in the vicinity of the A-frame derrick seen in the photograph, and is seen in more detail in another photograph.

The Marsch-Cleary-White Company, the general contractors for the entire work, retained for their own construction the concrete riprapping for the levees and bank slopes and all the work below the Washington street bridge.

The riprapping is done in 15-foot strips of 1:2:4 concrete, 4 inches thick, reinforced with No. 27 triangle mesh. The toe, shown in a photograph under construction, extends 6 to 10 feet below the low-water line. Concrete mixed in a ¼-yard Milwaukee mixer on the levee was put in place by steel chutes lying on the slope. In the photograph will be seen the tar paper used in shingle fashion to lead the water seeping out of the bank down to the toe of the riprap during laying and setting, where it was pumped out, thus protecting the concrete until it was fully set. The Lackawanna steel sheet piles seen in the coffer dam were driven with a 2,000-lb. drop hammer about ten feet into the gravel. About sixty feet of the coffer dam was in use at a time, and the water was let in as soon as all the slabs of the riprap had been completed.

The work of the general contractors did not differ materially from that described except that the concrete walls they built were those bounding the subways and so were not so heavy nor so deeply founded. Also, a large share of the fill was 12 to 16 feet of filling on streets well back from the river bank. Steam shovel, dump cars and dinky locomotive were used to move the dirt for the levee fills, much of which was taken from the area of the new channel just below the Washington street bridge, shown after the excavation was largely completed, in the accompanying photograph of that bridge.

At the lower end of their work a Monighan drag line excavator, traveling on rollers on a plank runway, was used for making the entire fill. It was run first along the edge of the area excavated, outside the levee lines, making the first fill for the levee. It was then run close to the top of this fill, scraping it to the proper line and slope and depositing the material farther to the rear.



WHEN THE USUAL JANUARY FLOOD CAME THIS WINTER THIS SECTION OF THE WALL WAS NOT COMPLETED. THE GAP WAS FILLED WITH SAND BAGS AND GRAVEL AND THE WATER WAS KEPT OUT, EXCEPT A LITTLE SEEPAGE, ALTHOUGH IT CAME UP ALMOST TO THE TOP OF THE PILE OF BAGS SHOWN. THIS VIEW WAS TAKEN ON THE RIVER SIDE OF THE WALL.

MUNICIPAL ELECTRIC LIGHT PLANTS IN MASSACHUSETTS

IT IS recognized by electrical engineers that steam generating plants for electrical supply are, generally speaking, more efficient and economical the larger the capacity of the station and its generating units. There is, no doubt, a limit to both, but, conversely, it is readily perceived that under a 700,000 kilowatt-hour capacity per year, the efficiency of a plant is markedly less than in larger stations.

The tendency of small electrical companies toward purchasing their electrical supply, either wholly or in part, from a large steam or water-power generating company, is being followed by municipalities, which in Massachusetts are either shutting down their isolated steam stations and procuring their whole supply from a large company, or else keeping the plant for night or auxiliary operation, according to conditions. A number of Massachusetts municipalities, also, have started municipal light plants with all purchased electrical energy, owning only their own poles and wires and acting as a distributing agency. This plan has proved very successful, obviating the responsibility for keeping up a small steam plant, and maintaining uninterrupted service, which is well-nigh impossible unless duplicate machinery is installed. It also enables towns to procure their electricity at a lower price than they would be able to produce it themselves, due to the large bulk in which the selling company produces the energy. This is especially true of towns buying from hydro-electric companies, a rate of about 2½ cents a kilowatt hour at the town's switchboard being the prevailing price paid.

The following table shows the towns purchasing energy, the company or municipality from which purchased, and the amount and price, for the year ended June 30, 1915:

Town.	*Purchased from.*	*Kw. hrs.*	*Rate.*	*Total.*
Boyleston	Conn. River Trans. Co.	22,930	2½c	$573.25
Holden	Conn. River Trans. Co.	80,660	2½c	2,016.50
Sterling	Conn. River Trans. Co.	67,840	2½c	1,696.00
W. Boylston	Conn. River Trans. Co.	83,826	2½c	2,095.65
City of Worcester	Conn. Riv. Tr. Co.	103,200	1.51c	1,561.20
Paxton	Worcester El. Lt. Co.	21,140	3c	634.20
Norwood	Ed. El. Ill. Co. of Boston	1,484,000	1.92c	28,504.40
Middleton	Danvers Mun. Plant	18,843	6c	1,130.58
Belmont	Camb. Elec. Lt. Co.	482,321	3.6c	17,363.55
Georgetown	Haverhill Elec. Co.	90,450	3, 4, 5c*	3,114.65
Littleton	Lowell El. Lt. Corp.	48,590	4.77c	2,317.29

*Sliding scale.

The larger municipal plants in the State, generating from 700,000 to 13,000,000 kilowatt hours a year, made an excellent showing, the costs comparing favorably with those by company plants of corresponding size and output.

STREET LIGHTING IN DETROIT

Detroit made one of the early successes in municipal street lighting, and the plant was the subject of much acrimonious discussion until the truth of the matter was fully demonstrated. This brief history of the plant and fuller story of the last year's operations shows the reasons for what has happened. We are indebted to Frank Mistersky, superintendent of the plant, for the data from the forthcoming annual report.

DETROIT was one of the first cities to adopt the electric arc lamp for street lighting. The first contract was made in 1883 for 22 arc lamps, at 50 cents per lamp per night, operated on a moonlight schedule. The next year, in 1884, a contract was made for 300 arc lamps, on an all-night schedule. The contract price was $95,000 for the year. Following contracts somewhat reduced the rate, but the lowest was $132.41 for each lamp for the year. This was found to be higher than paid in many other cities. For this reason, and because the service was exceedingly unsatisfactory, the citizens of Detroit decided to build a municipal plant. The first lamps operated from the public lighting plant were put in service April, 1895. The entire lighting of the city by the municipal plant began October, 1895.

The cost per lamp, for operation and maintenance, not including fixed charges, as interest, depreciation, etc., for the year ending June 30, 1896, was $68.52. The same cost for the year ending June 30, 1914, was $25.21. The greater part of this reduction has been made possible by the substitution of modern and more efficient apparatus for the equipment originally installed.

The plant was built for a capacity of 2,000 arc lamps. Five marine type engines belted to twenty 50-kw. arc dynamos and three 57½-kw. direct-connected arc dynamos furnished the power for this purpose. This equipment practically filled the entire available floor space in the engine room. Today, with only an extension of about sixteen feet to the engine room, the generating capacity consists of two 600-kw. units, two 2,000-kw. units and one 6,250-kw. unit.

The two 600-kw. generators are connected to reciprocating engines; the others are connected to steam turbines. There are 7,376 arc lamps in service at present and about fifteen hundred more will be added during the year. The output for last year was 15,677,255 kw. hr.

In the boiler room, the old 300-hp. boilers with hand fired furnaces are gradually being replaced by larger boilers equipped with modern stokers. Two new boilers will be purchased this year. A coal conveyor with overhead bunker has also been in operation for about two years. These improvements can be checked from one year to another in the consumption of coal per unit output. In 1898 the coal per kw. hr. was 5.23 lbs.; last year's records show 3.42 lbs. of coal per kw. hr., a reduction of more than 34 per cent. During this time the grade of coal used has been approximately the same. This year's contract for West Virginia nut, pea and slack, on a contract guarantee of 14,143 B.t.u., is on the basis of $2.25 per ton, delivered on the siding of the public lighting plant. All coal is purchased on a penalty or bonus basis.

About as good a showing has been made in reductions of cost in other directions. The trimming of the Brush arc lamps, which in 1898 was $16.45 per lamp per year, for carbons, globes and labor, was reduced to $3.98 per lamp when series alternating current lamps replaced the Brush lamps; and was again reduced to an average of about $2.06 per lamp per year for the 4-ampere luminous lamps, which are gradually replacing the series alternating lamps, of which there are only 2,337 now in operation in the outlying districts of the city.

The plant is favorably located at the river bank about halfway between the easterly and westerly limits of the city. Coal and carload lots of supplies are delivered directly into the yard of the plant over a spur track built for that purpose.

All electrical energy is generated at 2,300 volts, two-phase. For outlying districts this voltage is raised to 5,500 and 6,600 volts and distributed to five sub-stations—about three and one-half miles from the main station—from which the several arc circuits for the respective districts are carried.

In addition to the arc lighting, service is given to more than 200 public buildings, including school houses, fire department engine houses, police stations, libraries, public parks, etc., etc. This includes service for a connected load of 1,427-hp. in motors and more than thirty thousand incandescent lamps.

Wages paid to all help are about the same as paid by Detroit private corporations for the same service. The working day is eight hours. Every year ten days' vacation with pay is given to each employe. In case of injury while on duty, all expenses for medical attendance are paid by the commission, and full pay is given to the injured employe during the time that he is incapacitated for work. That conditions are agreeable to the workmen is proved by the fact that in every department there are many employes who helped in the construction and first year's operation of the plant.

If the municipal plant of Detroit has proved a success, it is due to the caliber of the men who have served as Public Lighting Commissioners. Some of Detroit's most eminent citizens have considered it an honor to be able to give of their valuable time and ability in the service of the city.

The following figures are based on operation of plant for year ending June 30, 1915:

Total kw. hr. output at the switchboard for year ending June 30, 1915		17,327,785
For year ending June 30, 1914		15,677,255
Increase in kilowatt hours		1,650,530
Increase, per cent		10.53
Expended for operation and maintenance for year ending June 30, 1915		$235,836.14
For year ending June 30, 1914		227,231.25
Increase		$ 8,504.89
Increase, per cent		3.74
Cash cost of operation and maintenance for year ending June 30, 1915		$235,836.14
Less credit:		
Sale of old material	$3,599.12	
Rentals	2,376.19	
Incandescent lighting of County Building, etc.	7,294.01	
Superintendence, use of tools, etc., for foreign work	690.58	
		13,959.90
Net cash cost of operation and maintenance		$221,876.24

The total output in kw. hrs. for year ending June 30, 1915, was divided as follows:

For arc lighting	14,198,043
For incandescent lighting and power service	3,129,742

The net amount expended for operation and maintenance proportioned between the arc and incandescent lighting, according to the output of each, is as follows:

Arc lighting	$181,800.99
Incandescent lighting and power service	40,075.25
Average number of arc lamps operated during year	7,487
Net cash cost per arc lamp, year ending June 30, 1915	24.28
Net cash cost per arc lamp, year ending June 30, 1914	25.21
Net cash cost per kw. hr., year ending June 30, 1915	0.0128
Net cash cost per kw. hr., year ending June 30, 1914	0.0134
Total number arc lamps in operation June 30, 1915	8,193
Total number arc lamps in operation June 30, 1914	7,343
Increase in number of arc lamps for the year	850

According to the Municipal Manual, compiled by the city clerk, the population of Detroit for 1915 was 673,498. With 8,193 arc lamps, this would give one arc lamp for every 90 inhabitants. The total length of streets is given at 757.14 miles. This would give an average of 9.88 arc lamps per mile of street. For the year 1914, with 710 miles of streets, the ratio was 9.44 arc lamps per mile of street.

From the foregoing, it will be seen that the cash cost per arc lamp for the year has been reduced 93 cents per lamp. This reduction has not been at the expense of the plant maintenance, as the report shows an expenditure of $2,397.82 for maintenance of buildings; $7,541.22 for maintenance of steam plant; $3,860.33 for maintenance of electric plant; $4,131.05 for maintenance of tools and machinery; $6,868.32 for maintenance of arc lamps and switches; $29,138.08 for maintenance of overhead lines and underground cables, etc., etc.

The result of such expenditures is shown in the record of lamp-outs. With a total of 29,207,855 lamp hours for the year, the total "outage" was reported at 30,649 lamp hours, or about .1 of 1 per cent.

During the year wages in all departments have been increased sufficiently to compare favorably with those paid by private corporations for similar work. This has enabled the commission to retain the services of competent employes. As long as the commission can pay its employes in accordance with their ability, and the value of their services to the public lighting plant, or to a private corporation, the Detroit public lighting plant can be in the front rank of municipal enterprises. But as soon as this ceases to be true, the Detroit public lighting plant will fall in line with hundreds of other municipal plants, the success of which is rather doubtful.

As it is, a number of employes leave the service of the public lighting plant annually, for the reason that private corporations will pay what a man is worth, whereas at least some of the salaries paid by the commission are fixed and cannot be changed, and those that are not fixed are limited, for at least the balance of the fiscal year, by the appropriation received for that year.

The entire public lighting system was in better shape at the end of the year than for some time. The additions built to three sub-stations made it possible to remove the hazard due to the limited space in which it was necessary to install required apparatus.

A "Safety First" committee, made up of heads of all departments, meets monthly to discuss possible hazards and to devise means of eliminating the same. A pulmotor was purchased to give prompt aid to employes unfortunate enough to require such assistance. It is also available to the general public upon call. An automobile and attendant is always available for the purpose.

Other improvements worthy of mention are the following:

A new 5,000-kw. turbine generator is now in operation. This, with the two new boilers now being erected, will make a considerable reduction in the station cost of the power output.

The construction of conduits in the Boulevard, in Jefferson avenue, Grand River avenue, Boston boulevard and Fort street West made it possible to illuminate these streets properly, and will ultimately permit the removal of objectionable overhead lines. Nothing in this line is more urgent than the construction of conduits and the installation of underground cables to replace the 5,500-volt sub-station feeders now carried overhead thru the streets and alleys of the city, in many instances within a very limited distance from high apartment buildings and buildings used for industrial purposes. This is an urgent "Safety First" measure.

The books show the present investment in the public lighting plant to be $2,598,467.04. But, after twenty years' operation of the plant, it would seem to be a good business proposition to get an inventory of the entire system, to determine what has been the actual cost of the street lighting. Since 1908 the commission has reported cash expenditures only, making no attempt to show depreciation charges, because no precise information is available.

. The personnel of the department for inspection of interior wiring consists of one chief inspector, sixteen inspectors, four clerks and one telephone operator.

The amount of the fees collected was $30,103.56. The expense of the department totalled $27,394.77. This included the purchase of three Ford automobiles, one for the chief inspector and two for inspectors on special work. The other inspectors use bicycles and motorcycles.

The total number of inspections made during the year was 73,944. The total number of defects found by the inspectors during the year ending June 30, 1915, was 14,694. The total number of certificates issued was 27,221.

During the year 2,745 inspections were made of old wiring installations; 484 of these were in industrial buildings, and 2,261 in other types of buildings. Of the 484 industrial buildings, 56 only were approved; in the others changes in the wiring were recommended. In other buildings changes were asked for in 820. Fees collected for the reinspection of wiring in 2,745 installations totalled $393.25 only.

Twelve complaints were filed in the Recorder's Court, on account of electrical work done without permit. In most of these cases sentence was suspended. One delinquent was instructed by the court that he must do no more electrical contracting in the city of Detroit.

In the inspection department for overhead lines it is reported that the two inspectors found 2,641 defects in overhead wires. Of these, 1,293 defects have been corrected, and the others will be remedied as soon as possible.

COMPARATIVE KILOWATT HOUR OUTPUT.

The following table comprises a listing of comparative kilowatt-hour output for twelve months prior to June 30, 1915:

	Arc Lighting	Incandescent Light and Power	Total Output
July	893,875	171,930	1,065,805
August	1,000,583	172,957	1,173,540
September	1,100,929	196,611	1,303,540
October	1,316,542	264,788	1,581,330
November	1,395,504	300,306	1,695,810
December	1,507,163	346,157	1,853,320
January	1,485,837	361,173	1,847,010
February	1,258,298	326,802	1,585,100
March	1,243,805	311,545	1,555,310
April	1,078,605	246,545	1,325,150
May	981,301	241,879	1,223,180
June	929,601	189,089	1,118,690
Totals	14,198,043	3,129,742	17,327,785

LAMPS AND HOURS OPERATED.

	Av. No. Lamps	Total Lamp Hrs. Scheduled	Total Outage Time Hrs. Min.
July	7,356	1,785,731	2,386:25
August	7,373	2,054,305	2,399:35
September	7,375	2,288,206	1,354:55
October	7,378	2,704,505	3,520:40
November	7,382	2,910,110	4,953:55
December	7,401	3,184,491	3,975:25
January	7,428	3,116,910	2,724:20
February	7,451	2,603,300	2,623:05
March	7,529	2,571,547	2,140:50
April	7,589	2,190,260	778:45
May	7,607	1,975,727	1,913:—
June	7,972	1,822,763	1,863:55
Av. and totals	7,487	29,207,855	30,649.50

ARRANGEMENTS OF SERIES ARC LAMPS.

The lighting of the city is done exclusively by means of arc lamps. The lights are placed on ornamental posts, mast arms, towers and cranes as the conditions demand. The 8,193 lamps in operation on June 30, 1915, were distributed in 7,924 locations as follows:

250 Cranes	250 Lamps
13 Center Suspensions	13 Lamps
5,277 Mast Arms	5,277 Lamps
2,157 Single Ornamental Posts	2,157 Lamps
137 Double Ornamental Posts	274 Lamps
9 Single Trolley Poles	9 Lamps
25 Double Trolley Poles	50 Lamps
28 Three-light Towers	84 Lamps
14 Four-light Towers	56 Lamps
1 Water Works Tower	4 Lamps
On Base of Towers	6 Lamps
In Buildings	13 Lamps
Total	8,193 Lamps

COST OF OPERATING PLANT FISCAL YEAR ENDING JUNE 30, 1915.

	Wages	Stores	Total	Pr. Kw. Hr.
Maintenance:				
Bldgs., track, dock, etc.	$ 1,044.03	$ 1,353.79	$ 2,397.82	
Steam plant	4,473.36	3,067.86	7,541.22	
Electric plant	2,979.05	881.28	3,860.33	
Misc. tools and mach...	1,140.99	2,990.06	4,131.05	
Conduits	674.80	521.50	1,196.30	
Towers and lamp posts.	1,302.00	485.06	1,787.06	
Arc lamps and switches	4,895.90	1,972.42	6,868.32	
Lines and cables	19,664.33	9,473.75	29,138.08	
Total maintenance	$36,174.46	$20,745.72	$56,920.18	.00329
Executive:				
Salary Sec. & City Elec.	$ 8,000.00		$ 8,000.00	
Ptg. and stationery		$ 848.88	848.88	
Store room	4,187.21	208.52	4,395.73	
Office expense	7,828.21	867.07	8,695.28	
Supt. & draughting	6,693.40	187.93	6,881.33	
Total executive	$26,708.82	$ 2,112.40	$28,821.22	.00166
Station:				
Oils		$ 481.28	$ 481.28	.00003
Waste		30.97	30.97	.00000
Coal		64,375.32	64,375.32	.00372
Misc. supplies		1,433.08	1,433.08	.00008
Wages	$38,523.88		38,523.88	.00222
Total station	$38,523.88	$66,320.65	$104,844.53	.00605
Lighting:				
Trim. & patroling	$18,831.10	$ 232.00	$19,063.10	
Electrodes		8,618.15	8,618.15	
Rectifier tubes		1,721.00	1,721.00	
Incan. lamp renewals		4,801.61	4,801.61	
Incan. lighting exp.	845.41	380.31	1,225.72	
Globes		2,471.47	2,471.47	
Misc. supplies		49.75	49.75	
Belle Isle Park	798.15	135.70	933.85	
Palmer Park	68.86	10.34	79.20	
Total lighting	$20,543.52	$18,420.33	$38,963.85	.00225
Shop supplies		$ 40.65	$ 40.65	.00000
Surgeon and hospital	$1,100.38	1,029.72	2,130.10	.00012
Relief fund	4,115.61		4,115.61	.00024
Total operat'g cost.	$127,166.67	$108,669.47	$235,386.14	.01361
12 mo. to June 30, '14.	$120,762.31	$106,568.94	$227,331.25	.01450
12 mo. to June 30, '13.	108,036.66	90,479.77	198,516.43	.01440
12 mo. to June 30, '12.	102,080.00	85,732.96	187,813.05	.01538
12 mo. to June 30, '11.	99,396.37	80,171.52	179,567.89	.01686

The work of trimming arc lamps is entrusted to the care of eleven men. There were 2,147 series alternating current enclosed lamps, 5,561 4-ampere and 485 6.6-ampere General Electric Company's luminous arc lamps in operation June 30, 1915. There are 129 circuits, averaging 60 lamps each. The total number of lamps of each kind and their methods of support are shown in the following table:

Boulevard ornamental posts (single)	485
Single ornamental posts	1,672
Double ornamental posts	137
P. L. C. mast arms	5,277
Center suspensions	13
Cranes	250
Single trolleys	9
Double trolleys	25
Towers	43
Tower lamps	150
Buildings	13
Luminous arc lamps, 6.6-amp	485
Luminous arc lamps, 4-amp	5,561
A. C. enclosed lamps	2,147

Following is a listing of the disbursements on investment accounts of the department for the period intervening from April 4, 1893, to June 30, 1915:

PUBLIC LIGHTING SYSTEM INVESTMENT.

Investment Accounts:	
Buildings and wharf	$ 318,025.97
Steam plant	459,018.95
Electric plant, arc	365,197.47
Electric plant, incandescent	66,259.23
Misc. tools and machinery	30,993.01
Conduits	541,517.82
Towers and lamp posts	237,217.55
Arc lamps and switches	258,419.18
Overhead lines	670,468.52
Cables	325,938.49
Belle Isle Plant	45,768.98
Palmer Park	10,444.44
Real estate	85,460.83
Railway track and scales	11,628.31
Total amount expended for investment	$3,426,358.75

The Municipal Supply Department—II.

STORE KEEPER AND STOREHOUSE

By Hugh M. Foster, New York City.

This is the second of a series of articles on the handling of supplies for municipal departments, and it is devoted to the most important single division of the department, the storehouse. Much money can be saved by intelligent, careful and honest administration of the stores, in purchase and in filling of requisitions. And much can be lost by inefficient, careless handling of requisitions and purchases of materials to fill them. Often the opportunities for dishonesty, particularly in taking "commissions" on purchases, are many. The storekeeper must therefore know his business and attend to it, must have good judgment, and must be absolutely honest.

THE greater opportunity for economy is in the stores division, rather than in the purchase division of the municipal supply department. The purchasing agent's achievement is in the reduction of prices, but the storekeeper's achievement is in the reduction of quantities, the control of distribution, the supervision of consumption and the basic, systematic structure of the whole function of furnishing supplies. Another great value of the storekeeper is his ability to act as a wholesome check upon the purchasing agent. For this reason he should be independent of the purchasing agent. For the system to be effective at its best, these two officials should work in harmony, but by keeping in close touch by daily communication each should furnish the other with all suitable information and act as a check on the other by means of such information, rather than in the spirit of carping criticism.

In establishing a general storehouse, the first and most important consideration is its location, which should be central, not only from a geographical point of view, but also from the point of view of facilities for receiving and issuing supplies.

The storehouse should be placed so as to afford the shortest route to the majority of subsidiary storehouses or minor receiving points for the consumption of supplies; also it should be equipped with all modern facilities for receiving and issuing supplies. If possible, it should be so located as to be reached both by rail and by water, with proper railroad sidings for unloading carload lots. Connection should be made with city trolley lines, so that a supply trolley car may be sent from store to various municipal receiving points. Such a trolley supply car should be similar to the trolley car used by express companies for suburban deliveries.

In a general storehouse, systematic arrangement in handling facilities—bins, shelves, racks, scales, tracks, carts, crates, trucks, etc.—should be carried to the most scientific development. The same systematic design should prevail in the facilities for issuing supplies, in the equipment of automobile trucks, wagons, carts, and in the packing and shipping room.

The whole general storehouse should be subdivided into sections, with a section foreman in charge of each. In that section should be only one classification of supplies. The supplies most frequently used and in small quantities to be issued over the counter to workmen or shop foremen should be nearest the entrance for such workmen.

The care of supplies in stores is quite as important, because many kinds of supplies will deteriorate thru improper care, such as lime, cement, paints, flour and feeds.

The tool room is one of the most important parts of the storehouse. In it should be a properly designed place for every known tool. Each tool should be marked with a number corresponding to the place where it belongs. Tools carried in stock, and which are required for a particular job but not longer, may be loaned to workmen on loan requisitions and charged to the workmen during the time of use. Expensive tools and tools subject to temporary use may be made more durable by being under the charge of the foreman of the tool shop and kept in proper repair. All tools, and, in fact, all city property susceptible of such identification should be conspicuously branded or marked to prevent theft, and no new tool should be issued to a workman except upon return of the old tool for the scrap heap.

One great advantage in a general storehouse over many storehouses scattered thruout various branches of the municipal government is that by concentration in one place, surplus stock can be enormously reduced. In the decentralized system, while one institution is in urgent need of a given article of supply, some other institution may be carrying an old surplus of that same article, and the institution in actual need forces the emergency purchase at great disadvantage. By centralizing in one general storehouse, the minimum of stock would be in any institution, and surplus would be forwarded as needed from all subsidiary branches. Therefore the need of any institution could be satisfied at once from stock.

The general storekeeper should have supervisory control of all requisitions, and by complete statistical records should recognize at once any unusual requisitions, and upon request should be furnished with further information explaining the reasons for any such unusual request, either as to article or quantity. A daily balance account should be kept showing the exact state of business at the end of each day, and this should be forwarded in duplicate to the purchasing agent and to the comptroller.

Next to the general storehouse should be placed a yard for castings and heavy metals, pipe racks and lumber sheds. The closer the general repair shops are to the general storehouse, the greater the service the latter can render the former. It is another evidence of waste of the decentralized condition for the department of street cleaning, the fire department, department of docks and ferries and any other department which carries on great repairs and construction, to have their repair shops separate. These should all be centralized in one great repair plant situated next to the general storehouse.

The importance of complete statistics to the storekeeper is as great as, if not greater than, to the purchasing agent. Correct storekeeping aids purchasing, distribution, cost accounting and efficiency of management.

In the general storehouse stock cards should be kept for every article of supplies, which should show their receipt and issue, with their dates. The difference between the issues and receipts shows at any time the amount on hand. Such stock cards may be kept on the bins, shelves or other receptacles for the supplies, or may be kept in the office of the general

foreman of the store in a card-index cabinet. Such cards should bear a location number similar to the library system, showing the location of every article in stock.

Supplies should be furnished only on written requisitions from those authorized to make them, and bearing all proper certifications.

Each section foreman knows his own stock, and by watching carefully the consumption of his stock, he informs the general storekeeper in anticipation of a lack, and so prevents running short. In each section should be kept on hand a "want book," in which the section foreman should record any article called for which is not in stock, or which is not intended to be carried. This record should be reported monthly to the general storekeeper, and if the number of such calls warrants it, the articles should be carried in stock.

To every requisition made by the general store keeper on the purchasing agent should be attached a perforated stub for notice of delivery. On this stub should be indicated the actual date when the supplies are needed in the storehouse, and the date of promised delivery should be filled in by the vendor, so that the storekeeper may be informed of date of delivery and prepare for the reception. By such a system and a proper method of tracing delivery and following up notices, the purchasing agent is kept informed of dealers who are delinquent in delivery.

Under the decentralized system of handling supplies, one of the greatest abuses is the enormous proportion of purchases made on open market orders; that is, without due contracts and often without fair competitive base. The total purchases by the open market method for a given year may approximate 25 per cent. or 30 per cent. of the whole expenditures for supplies to the city, whereas, in a well regulated corporation, such purchases do not amount to more than 3 per cent. to 5 per cent. As a matter of fact, such open market purchases should be confined only to actual emergencies, and even in such cases, the emergency should be certified to by the head of the department, explaining fully the causes which lead to such a condition. An emergency purchase is always at a disadvantage. Another phase making for greater efficiency in scientific management of stores is the opportunity offered for correct cost accounting.

Supplies issued from the general storehouse to branch storehouses or to institutions for consumption should be charged against the consumer at a price averaged from the price obtained by purchase covering a period since the receipt of the first purchase of the article. That is, if a given article is purchased in one month at a given price, and another month at a different price, and the articles are such they they cannot be kept separate, but must be mixed in one receptacle, they should be charged at the average of these two prices.

Besides the perpetual inventory maintained in a storehouse by stock cards, the comptroller should make an annual inventory based upon actual physical count as a check upon the storekeeper.

A central storehouse should be a clearing house for the receipt and distribution of supplies, and it should never be considered as a repository for supplies. The ideal theory of a storehouse is that of a water reservoir which sends out the same amount of water which it receives. The test of a storekeeper and his ability to manage a storehouse is determined by the approximation of issues to receipts. The ideal condition is equality of different issues and receipts. Of course, this is an ideal and is never actually attained. If his receipts greatly exceed his issues, his stock is growing, and the storekeeper is merely piling up surplus. If his issues greatly exceed his receipts, his stock is running short, and he is rapidly approaching the catastrophe of being unable to supply needs.

A separate division of the general storehouse should be a cold storage plant for the storage of perishable supplies, such as meat, fresh fruits and vegetables, butter, eggs, etc. The advantage in having cold storage facilities for such supplies, rather than having them bought and delivered daily or weekly, is that they can be bought in larger quantities and consequently at lower prices, and also they can be bought at the season when the market is low. This is particularly true in the case of butter and eggs.

The same general principle as the purchasing and storing of perishable goods applies to coal. That is, the market for coal is low in the late spring and early summer. Therefore, by buying in the largest quantities at that time of the year the best prices can be obtained. For that reason it would be to the advantage of the city to maintain adequate coal pockets.

Adequate forage sheds should be maintained with a capacity of a year's supply, for the method of purchasing, delivering and using forage in driblets and diffused over many delivery points extended thruout an enormous territory, is an economic waste.

BIG CHICAGO BRIDGE COMPLETED

The Jackson boulevard bridge, city of Chicago, has been completed by the sanitary district of Chicago under the act of the General Assembly of the State of Illinois empowering the district to remove obstructions from the Chicago river. The rebuilding of this bridge has been a subject of controversy for many years, the sanitary district trustees desiring a span that would cause no obstruction in the river, while the railroad companies owning property on the west side of the river had refused to permit any encroachment on such property on the ground that it would make impracticable the proposed new Union Terminal Station.

It was the intention of the sanitary district to make a record for minimum interruption of traffic across the river due to construction of the new bridge, and it was specified that the west abutment should be partially built under the old swing bridge while the latter remained in service, that the old bridge should not be removed prior to March 15, 1914, and that the new bridge should be ready for traffic on April 1, 1915.

Work was commenced in February, 1914, and the old bridge continued in service until May 11, 1914. Due to labor strikes and to serious and unforeseen difficulties encountered in constructing the abutments, the work was prolonged considerably beyond the time specified in the contract.

The bridge is 274 ft. long from end to end and consists of two movable leaves, one 123 and the other 128 ft. long. The roadway on the bridge is 37 ft. wide in the clear between curbs and is paved with creosoted wood blocks resting upon a solid floor of 6-in. creosoted planks. The two sidewalks have a width of 13 ft. each from curb to railing, and the entire bridge is 64 ft. wide, out and out, as wide as can be made to open between the abutting buildings.

MUNICIPAL SEWER CONSTRUCTION

IN MOOSE JAW, SASKATCHEWAN

War conditions brought about the circumstances described in this article, which shows what can be done with comparatively inefficient and inexperienced labor under the worst of weather conditions, when "needs must." The financial results are remarkable when all the conditions are considered.

THE city of Moose Jaw, Saskatchewan, is so located that all its sewage must be pumped into the disposal works. It has, therefore, been necessary to adopt the separate system of sewerage. A system of sewers for house drainage was constructed some years ago and has been extended as the growth of the city demanded.

Until recently the surface water drainage of the city was taken care of by Thunder Creek and Moose Jaw Creek, which unite near the Eleventh Avenue subway, with help from an occasional storm sewer, the first of which was constructed in 1906. But as the city grew, very rapidly, and streets were graded, many small natural watercourses, thru which storm water had reached the streams over the surface, were obliterated and serious flooding of certain streets and the abutting property occurred each spring. To improve this state of affairs, plans were made for systems of storm sewers in four districts. One of these sewers, recently constructed, is 7,744 feet long and varies in diameter from 30 inches to 12 inches. Bids for the sewer showed the following comparative prices for the larger sizes:

	Vitrified Tile	Segment Block	Concrete
24-inch	$1.75	$1.80	$1.75
30-inch	3.32	2.30	2.60

Tile pipe from the Redwing Sewer Pipe Co. and the Alberta Clay Products Co., Medicine Hat, were used for the 24-inch size, and segment block from the American Sewer Pipe Co., Akron, Ohio, were used for the 30-inch.

The contract was let just before the war began, and on account of the war it was cancelled. Later, when the problem of the unemployed during the winter season become acute, the city council decided to construct the sewer by day labor. The work began in December and was completed in March. Winters in Moose Jaw are severe, the temperature being below freezing at all times, and falling as low as 40 degrees below zero. To relieve as many as possible, the men in the gangs were changed each week, and any one man averaged about one week's employment in three. The number of men employed averaged 57 each day. The cost data for this article are from a paper in *The Canadian Engineer*, by George D. Mackie, the city engineer-commissioner, who expresses the opinion that the efficiency of the labor was not 50 per cent. that of a regular laborer in the same line, as the men employed were from all trades and employments, unfitted for and unaccustomed to such work.

Notwithstanding the inefficient labor and the extra cost of doing work in the winter, the total cost of the work, $26,795.63, compared very favorably with the contract price computed from the bids given above, $25,008.89. The laying of the segment blocks, for example, can be done under ordinary conditions for about one cent per foot for each inch diameter of sewer, but in this case the blocks were heated and bedded in hot moist sand and covered with the same until the cement in the joints could set. The men tending fires, and the fuel, were extra, and there was some extra work, if not extra pay, for the handling of the sand and blocks into and out of the heat. The cost to the city included all clerical work, supervision, insurance of men, rental of tools and the maintenance of the sewer for six months after completion.

The following tables show the cost of building the sewer and of building manholes and catch-basins. The statements of depth to which frost extended in the trenches are of interest, as indicating the extra cost of excavation. They also explain the tunneling shown in the accompanying photograph and the slight bracing necessary, especially in the upper part of the trenches.

COST OF STORM SEWERS PER FOOT.

Size of pipe	12-in.	15-in.	18-in.	20-in.	24-in.	30-in.
Material	Tile.	Tile.	Tile.	Tile.	Tile.	Seg. Block.
Length of section	1581 ft.	1509 ft.	1134 ft.	2086 ft.	635 ft.	797 ft.
Average depth	6.6 ft.	7.00 ft.	9.5 ft.	7.25 ft.	11.0 ft.	12.5 ft.
Nature of soil	Gray clay, 6 ft. frost.	Clay and gravel, 7 ft. frost.	Gray clay 5 ft. frost.	Clay and gravel, 3 ft. frost.	Clay and gumbo, 5 ft. frost.	Gumbo, 4 ft. frost.
Yardage per lin. ft.	.65	.70	.90	.80	1.22	1.85
Cost per lin. ft. excavation	$ .65	$1.01	$1.03	$ .49	$1.34	$1.75
Backfill	$ .05	$ .07	$ .13	$ .13	$ .30	$ .40
Teaming, watching, timekeeping, etc.	$ .14	$ .16	$ .16	$ .22	$ .22	$ .70
Pipe laying	$ .06	$ .06	$ .09	$ .12	$ .13	$ .52
Material	$ .60	$ .93	$1.19	$1.41	$2.01	$2.89
Total cost	$1.50	$2.23	$2.60	$2.37	$4.00	$6.26
Estimated cost	$2.00	$2.25	$3.00	$3.00	$4.00	$5.00

COST OF MANHOLES AND CATCH BASINS.

	No.	Vertical Feet	Total Cost	Unit Cost	Cost per Vertical Foot With Covers	Cost per Vertical Foot Without Covers
Manholes—Concrete	25	206	$1,710.37	$68.41	$8.30	$4.45
Brick	4	48	395.70	98.92	8.24	5.74
Catch Basins—Concrete	44	249	1,425.32	32.40	5.73	3.69

Materials—Sand, $1.80; gravel, $2.30; crushed stone, $3.30 pere cubic yard. Cement, 75 cents per bag F. O. B. the job. Labor, 25 cents per hour.

There were also 1,219 lin. ft. of catch basin connections, connecting the 44 concrete catch basins with manholes, there being 4 basins at each street intersection. These lines averaged 4.5 feet depth and were frozen to the bottom of the trench. Two connections at each street intersection were tunneled under the street railway track. The cost, 84.5 cents per lin. ft., for these catch basin connections was therefore somewhat high.

The catch basins had 9-inch concrete walls and 2.5 ft. inside diameter, of 1:3:5 proportions of concrete materials and plastered with an inch of 1:1 mortar. Concrete manholes were of like construction and of 3.5 ft. inside diameter. Four manholes of irregular design, because of their location and obstructions encountered, were built of brick. Costs of all are given in the last table above.

BUILDING A VITRIFIED SEGMENT BLOCK STORM SEWER IN MOOSE JAW BY DAY LABOR IN SEVERE WINTER WEATHER. DEPTH OF FROST MAKES TRENCHES SOLID ENOUGH TO REQUIRE LITTLE OR NO TIMBERING AND ALMOST TO REQUIRE TUNNELING UNDER THE FROZEN DEPTH. WARM BLOCKS, WARM SAND, WARM WATER AND PROMPT BACK FILLING MADE THE WORK POSSIBLE.

WATER METER RATES RECOMMENDED BY NEW ENGLAND WATER WORKS ASSOCIATION

A committee of the New England Water Works Association, named to consider problems pertaining to water rates, has rendered its report, with recommendations and a standard form for rates. It is suggested that for domestic service with ⅝-inch meter, the ordinary service charge may properly be about $3 per annum where service and meter are paid for by the taker; $4 where the meter is furnished by the works, and $5 or $6 where both meter and service pipe are paid for by the works, the lower figure being used where the average cost of the service pipe is under $15 and the higher rate where it is over $15. These charges are, however, subject to modification due to local conditions.

It is desirable, the committee says, that the price per 1,000 gallons or per 100 cubic feet be an even number of cents, without fractions, and that the domestic rate and manufacturing rate be first fixed. The latter should seldom be less than half the former, and for the intermediate rate the price should be to the nearest cent midway between the average and the mean proportional of the two. The minimum charges for services with meters larger than ⅝-inch may be fixed at larger sums, computed according to methods indicated in a previous report.

A flat rate for all quantities may be made by fixing the same price for water for domestic purposes and for manufacturing purposes. The committee recommends that where the same works supply water in different services, under conditions imposing much greater relative expense in one or more services as compared with others, because of high-service pumping, etc., it is fair to add the extra cost to customers supplied in those districts, according to ascertained costs.

It is recommended that the statistics of sales by meter be classified on the basis of 300,000 gallons or less per year, as constituting the domestic rate, 300,000 to 3,000,000 gallons the intermediate rate, and over 3,000,000 gallons the manufacturing rate. For quantities in cubic feet, the first 10,000 cubic feet quarterly would constitute the domestic rate, 10,000-100,000 cubic feet the intermediate, and over 100,000 cubic feet the manufacturers' rate. Monthly bills would be reckoned on the basis of the first 3,300 cubic feet as the domestic rate, 3,300-33,000 the intermediate, and over 33,000 cubic feet the manufacturers' rate.

Rates should be fixed so as to produce the required revenue, and according to local conditions.

Gravel as an Aggregate for Concrete

By Prof. H. H. Schofield, Purdue University, and Charles C. Brown, Consulting Engineer.

Specifications for gravel have never been written, that material being treated as tho it were broken stone, whereas it is a very different material and requires very different treatment to obtain the best results. This study of the data regarding gravel and sand for concrete demonstrates the need for further tests and for the development of a real gravel specification.

THE consumption of gravel as an aggregate for concrete has been estimated to be nearly 50 per cent. of all the aggregates used in the nation. In states, such as Indiana, having great natural deposits of good gravel, the consumption is much larger in proportion.

Hitherto there has been no rational or complete specification for gravel as an aggregate. The specifications which are in use oftentimes permit the use of an inferior material, or what is more important and common, exclude gravels which with proper treatment will make excellent concrete. This latter fact often causes a waste of good material in some localities. In the opinion of the writers of this paper, a specification should be rigid enough in its requirements to insure good and uniform concrete, and elastic enough to allow the use of as much of the natural deposits as possible.

No doubt one great reason for this neglect of the specification for gravel is to be found in the fact that there is so much variation in that material, the layers in the same pit or stream varying among themselves, and the gravels in one district being quite different from those in another; and at the same time practically satisfactory concrete is obtained from these varying gravels without a standard specification, dependence being placed on inspection, subject to individual opinion and experience. This results in the vast waste of good material just referred to, and in a somewhat lower average of concrete produced therefrom.

The relation of the sand and gravel in concrete is so intimate that it is impossible to consider the gravel without at the same time considering the sand, and it is by no means certain that the usual line of division between sand and gravel is the proper line, or that the dividing line should always be at the same point for all gravels.

There have been some studies of broken stone and of the proper proportions of sand and stone for stones of various sizes and gradings, and fairly satisfactory concrete specifications for sand and broken stone mixtures of certain sizes and gradings of sizes have been devised. It seems, however, to have been assumed that all other coarse aggregates have the same qualities as the broken stone and they are all lumped together under the specifications for broken stone concrete.

To secure uniformity of product it is necessary that a "Run of Bank" or "of Plant" gravel be separated into at least two parts, a fine and a coarse aggregate, and then be re-combined in some definite pre-determined proportion.

The idea of separating and re-combining aggregates probably originated with the paper of Fuller and Thompson, published in the Proceedings of the Am. Soc. of C. E. in 1907. The principal conclusions brought out by these authors which are directly applicable to the problem of a gravel specification, are these:

1. Artificially graded aggregates give about 14 per cent. better strength than naturally graded ones. (In their tests.)
2. Variations in the grading of the sand affect the strength and density more than the grading of coarse aggregate.
3. The term sand is a "relative" one; with a 2¼-inch stone the best sand ranged from ¼-inch to 00, while for ½-inch stone it would range from .05 to 00.

In view of the fact that the present specifications have little to say as to how the fine aggregate shall be graded and also specify sand of one size only, namely ¼-inch—00, it would seem that more investigation should be made and revision obtained if necessary.

The proper grading of the fine aggregate has not as yet been fully determined. Numerous tests of sands have been published but never with that particular object in view. Professor Schofield has studied the results of some of these investigations to gain some information with regard to the effect of grading on the strength of the resulting mortars.

In the Bulletin No. 331 of Geological Survey, United States Department of the Interior, are recorded the results of tests of twenty-two natural sands and twelve sands screened from gravel deposits. The straight line of "uniformly" graded sand is also given as a comparison for the grading. These sands were all tested under the same conditions and were collected from various parts of the United States. A review of one or two other publications is also given as a matter of more information on the subject.

TABLE I: TESTS OF 22 NATURAL SANDS U. S. GEOLOGICAL SURVEY. *Bulletin No. 331 by Humphrey and Jordan.*

Sand.	Sieve Analyses (Per Cents) 0-80	80-20	20-10	10-¼"	Density	1 to 3 Strength (lb. sq. in.) 360 days Ten.	Com.
"Uniformly' Graded sand...	2.7	10.8	15.5	71.0	...	...	....
Average of all...	6.0	56.1	19.7	18.2	.745	542	5073
Coarsest sand....	1.5	30.8	27.5	40.2	.760	605	7108
Finest sand.....	15.3	80.5	1.8	2.4	.676	331	2633
Strongest	2.1	45.0	22.2	30.7	.763	720	7554
Sands	2.1	42.1	26.9	28.9	.789	773	6719
Weakest sands...	15.3	80.5	1.8	2.4	.676	331	2633

TABLE II: TESTS OF 12 GRAVEL SCREENINGS PASSING ¼" SIEVE, U. S. GEOLOGICAL SURVEY—*Bulletin No. 331.*

Sand.	Sieve Analyses (Per Cents) 0-80	80-20	20-10	10-¼"	Density	1 to 3 Strength (lb. sq. in.) 180 days Ten.	Com.
"Uniformly' Graded sand...	2.7	10.8	15.5	71.0	...	...	....
Average of all...	3.1	26.7	12.8	54.7	.768	621	6641
Coarsest sand....	0.0	0.0	.7	99.3	.791	654	8567
Finest sand.....	4.5	56.2	11.3	28.0	.759	703	5570
Strongest	0.0	0.0	.7	99.3	.791	654	8567
Sands	1.5	27.1	26.1	45.3	.796	737	7825
Weakest	9.2	6.8	5.0	79.0	...	426	4654

TABLE III: TEST OF 30 ILLINOIS SANDS, ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS—*Bulletin No. 70.*

Sand.	Sieve Analyses) Per Cents) 0-74	74-16	16-8	8-4	1 to 3 Strength (lb. sq. in.) 90 days Tension
"Uniformly' Graded Sand...	4.0	17.0	25.0	54.0	...
Average of all....	13.7	69.2	13.5	3.6	289
Coarsest sand....	6.0	42.7	32.8	18.5	428
Finest sand.....	55.6	44.3	0.1	0.0	211

Strongest	5.0	50.0	28.0	16.0	464	
Sands	1.1	60.2	36.5	2.2	454	
Weakest sand....	35.3	64.6	0.1	0.0	140	

TABLE IV: TESTS OF WISCONSIN NATURAL BANK SANDS, BY M. O. WITHEY—PROCEEDINGS OF AMERICAN SOCIETY FOR TESTING MATERIALS, 1913.

Sand.	Sieve Analyses (Per Cents) 0-74	74-20	20-10	10-¼"	1 to 3 Strength (lb. sq. in.) Ten.	Com.
"Uniformly' Graded sand...	2.9	10.8	15.3	71.0		
Average of all...	9.1	53.8	16.6	20.5	481	3816
Coarsest sand....	3.8	40.7	23.2	32.3	620	4150
Finest sand.....	18.2	81.7	0.1	0.0	235	1700
Strongest	8.7	40.1	20.9	30.3	710	4800
Sands	0.7	47.0	24.3	28.0	475	4900
Weakest sands...	18.2	81.7	0.1	0.0	235	1700

TABLE V: TESTS OF INDIANA BANK SANDS, BY H. H. SCHOFIELD, PROCEEDINGS OF INDIANA ENGINEERING SOCIETY, 1914.

Sand.	0-80	80-20	20-8	8-¼"	Density	1 to 3 mortar 360 days Ten.	Com.
Approx. "Uniformly" Graded (Co'rs't).	0.0	6.0	29.0	65.0	.79	546	5542
Next coarsest....	20.0	5.0	32.5	42.5	.75	658	6125
Next coarsest....	0.0	20.0	40.0	40.0	.75	619	5987
Next coarsest....	6.7	25.3	41.2	26.8	.75	555	5640
Next coarsest....	15.8	28.7	37.8	17.7	.73	536	5221
Finest sand.....	40.0	4.0	24.0	32.0	.70	450	4654

TABLE VI: TESTS OF INDIANA BANK SANDS, BY H. H. SCOFIELD.

Sands	0-80	80-16	16-8	8-¼"	¼"-½"	Density	1 to 3 mortar 42 days Ten.	Com.
Medium ..	40.0	60.0	0.0	0.0	0.0	.661	249	1745
Fine	67.0	33.0	0.0	0.0	0.0	.647	235	1338
Coarse ...	17.0	83.0	0.0	0.0	0.0	.719	254	2040
	0-40	40-16						
Fine	65.0	23.0	12.0	0.0	0.0	.695	293	1606
Medium ..	40.0	29.0	31.0	0.0	0.0	.723	347	2035
Coarse ...	16.0	29.0	55.0	0.0	0.0	.765	373	3470
Fine	58.0	22.0	7.0	13.0	0.0	.706	295	2385
Medium ..	31.0	24.0	13.0	32.0	0.0	.768	363	3248
Coarse ...	6.0	10.5	20.5	63.0	0.0	.825	515	3858
Fine	46.0	20.0	14.0	11.0	9.0	.752	438	2473
Medium ..	20.0	18.0	22.0	11.0	29.0	.788	457	3605
Coarse ...	3.0	5.5	10.0	31.5	50.0	.813	478	4838

Note: Above values are averages of at least three determinations.

From a study of the foregoing tests, the following points are evident:

1. The average natural sand and gravel screenings are much finer than the so-called straight line or "uniformly" graded sand.

2. The coarsest sand is not necessarily the strongest. The sand whose curve runs just a little above the uniformly graded sand appears to be the stronger in some cases.

3. The finest sands are nearly always the weakest.

4. The amount of material below a No. 80 size, corresponding closely to the size of cement, has a great influence on the strength of the resulting mortar.

5. The sand which gives the strongest mortar in tension is not necessarily the strongest in compression.

6. A sand which is all finer than a No. 80 sieve can give better strength and density than one which grades up to ¼-in. if the former is properly graded and the latter is near the upper limit in its amount of fine material.

What has been said concerning the fine aggregate can also be said with reference to the coarse aggregate, altho variations in grading will probably have less effect on the strength of the resulting concrete. A point with regard to the latter which has special reference to concrete roads is the wearing resistance of concrete and the influences which affect it.

From a review of the abrasion tests of concrete made by Professor Shoop of the University of Minnesota, it is evident that here again the wearing value of the surface of gravel concrete depends to a great extent upon the mortar; inasmuch as when the mortar wears more rapidly than the stones, these loosen and fall out producing pits and pockets. This characteristic might be exhibited in a road surface itself under the action of traffic.

It is very clear that there is need of an investigation for the purpose of fixing a rational specification for gravel for concrete. Such a specification should take into account, among other things, the durability of the particles, the grading, the cleanness and the proportions for different classes of natural gravels and for different classes of work.

The specifications for fine and coarse aggregates for concrete pavements adopted by the American Society of Municipal Improvements in October, 1915, follow very closely the specifications adopted by the American Concrete Institute, with the addition of the Deval Test of Aggregates, and read as follows:

2. Fine Aggregate: Fine aggregate shall consist of natural sand or screenings from hard, tough, durable crushed rock or gravel, consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating. Fine aggregate, when dry, shall pass a screen having four (4) meshes per linear inch; not more than twenty-five (25) per cent. shall, pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent. shall pass a sieve having one hundred (100) meshes per linear inch. Fine aggregate shall not contain vegetable or other deleterious matter nor more than three (3) per cent. of clay or loam.

Fine aggregate shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts fine aggregate, by weight, when made into briquettes, shall show a tensile strength (at seven [7] and twenty-eight [28] days) at least equal to the strength of briquettes composed of one (1) part of the same cement and three (3) parts Standard Ottawa sand by weight. The percentage of water used in making the briquettes of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquettes of standard consistency. In other respects all tests shall be made in accordance with the report of committee on uniform tests of cement of the American Society of Civil Engineers.

3. Coarse Aggregate: Coarse aggregate shall consist of clean, tough, crushed rock or gravel, or slag of approved quality in graded sizes, free from vegetable or other deleterious matter and containing no soft, flat or elongated particles.

The sizes of the coarse aggregate shall be such as to pass a one and one-half (1½-in.) inch round opening, and shall range from one and one-half (1½-in.) inch down, not more than five (5) per cent. passing a one-quarter (¼-in.) inch round opening, and with no intermediate sizes removed.

Its "co-efficient of wear" as determined by the "Deval Test" shall not be less than twelve, and its crushing strength shall not be less than twenty thousand (20,000) pounds per square inch.

The methods of determining the proportions of the aggregates to be used differ in the two specifications.

These specifications are typical of the ordinary specification, being somewhat better than the average.

It does not seem possible that a specification using broken stone aggregates, which are supposed to be roughly cubical but are of quite different shapes according to the structure of the stone from which they are made, would fit gravel, the shapes of the particles of which are so very different and the sizes and shapes of the voids in which are also so different.

A comparison may be made with the methods used in determining the grading of sizes to be used in the bitulithic pavement to indicate a method of study of the various coarse aggregates for concrete to show their differences, and therefore the necessity for differences in specifications. In the original studies for that pavement a cylinder was filled with stones of the largest size proposed to be used and they were shaken down until no more could be put in. The voids were then filled with plaster of paris, the mass was carefully disintegrated and the sizes and shapes of the voids between the stones were determined. A size of stone deemed best to fill these voids was then selected and this size of stone was then shaken down into a cylinder full of the large stones until no more could be worked in. The remaining voids were then studied and the process was repeated until fine dust had been worked in. The voids could be reduced in this way to perhaps 5 to 8 per cent. and the proportions of each size had been determined.

Practically each kind of stone to be used in a pavement is studied in a similar manner, except that the number of sizes of stone to be used in making the mixture is reduced to three and the proportions of these three sizes, as well as their limitations of sizes are determined, and the aggregate for the pavement is made up of these three sizes in the required proportions by weight. The voids are naturally in greater per cent. than in the theoretical sample, but they are reduced to a practical minimum.

A similar study of the voids in gravel would soon demonstate the truth or falsity of our contention that they are different in size and shape from those in broken stone and that they require a different proportioning and limits and grading of the fine aggregates.

Indeed, the best results with broken stone concrete require study of the products of the various quarries and crushers to determine the proper proportions and grading of fine aggregates.

Quite a number of studies of sand and gravel have been made for different purposes. .That the specification drawn with the data obtained from such investigations should be practical, goes without saying. It is not truly rational unless it is usable in daily practice.

RECORDS OF STREET AND ROAD REPAIRS

In a paper before the American Association for the Advancement of Science, Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, makes a plea for the application of system to street management, from which the following is abstracted:

State highway departments, collegiate institutions, and even the Office of Public Roads of the United States, have deemed it advisable to construct various types of roads, and roads of like type of somewhat different construction, with a view of study, recording data, watching behavior, keeping a correct cost, maintenance and repair charge, comparing wear and tear, in an endeavor to reach some conclusion and gather some testimony as to the value of such roads. The endeavors of these organizations are as nearly practical as possible under existing circumstances, but conclusions are drawn but from one character of travel. The conclusions are reached from conditions that are widely different from those actually existing on our streets as a whole, no two of which bear the same travel.

Streets which are improved are of various types.

They are in various states of repair.

They are of various locations.

Even a single street receives a variety of travel.

Single streets are often of such location that sections receive more or less travel.

The streets overlie varied conditions of soil.

Some streets are susceptible of easy natural drainage.

Other streets must receive artificial drainage.

The choice, the character, the type, the cost of all, are subject to a greater or less extent to whim, to notion, to low cost, to influence of zealous promoters, to one neighbor selling out another; in almost every case to any consideration other than those upon which good, sound judgment should be based.

Chaotic and inexcusable street and road mismanagement has been allowed existence because streets and roads are sustained by donation in one form or another; their earning capacity is not held to account. In a commercial establishment, if a like method of conducting business was permitted, the institution would soon fall into bankruptcy.

A business plan of street and road management should be put into operation which would furnish accurate information as to original cost, cost of operation and service, usually designated as maintenance and repair; would supply such supervisory oversight that when a break occurs it could be at once determined whether or not it was due to wear and tear or an original defect in some part; would deal systematically with cuts and openings and replacements and effectually regulate that annoying privilege.

Separate these streets into certain divisions and these divisions into sections, in no case exceeding one mile in length. These sections must be measured, numbered and recorded for the purpose of complete identification. To illustrate: East Forty-fifth street, division No. 9, section 17, beginning at the north property line of Superior and ending at the south property line of St. Clair, including intersections therein, 4,800 feet in length. The information required about this particular section of street can then be definitely recorded and classified and attached definitely to its records. With the full information which it is possible to gather and locate under such a plan, the adaptation of streets of various types and kinds to various service, in a short time will become apparent not only to the student applying a refined study to the situation, but to the layman as well.

Every county should be required by law to establish a complete identification of its roads in divisions not exceeding two miles in length, located by township and section, and such identification should be made of record. In all cases of contract for construction, reconstruction, resurfacing, maintenance and repair, expenditures therefor should be charged against the particular section upon which the expenditures were made. By such a plan of road and street management, the best judgment as to economy of the road could be exercised on account of the ability to trace the dollar to the actual thing purchased or work done for the particular road. Aside from this benefit, data, experience and comparison would become available for judgment as to future construction of roads. Street and road improvement, maintenance and repair would shortly become scientific, systematic, business-like operations, and millions now wasted would be saved.

Comparison of Team and Tractor

FOR HAULING GRAVEL

By O. L. Kipp, District Engineer, State Highway Dept., Redwood Falls, Minn.

A practical demonstration is always convincing. This comparison of hauling costs by animal and by motor power is such a practical demonstration. The article also shows conclusively the intimate connection of the methods of loading and unloading wagons and trucks with the economy of hauling. The motor truck requires much better loading facilities in particular, and when it has them its economy is vastly increased.

THE data that will be presented and the conclusions that may be suggested are derived from the gravel checker's records on five team hauling jobs totaling 22 miles of road gravelled and one tractor-hauling job covering 3.6 miles of road gravelled, the gravel being placed at the rate of 15 cubic yards per 100-foot station on each job.

Gravel hauling by team is familiar to all, and no description of outfit or method is necessary other than the statement that ordinary dump planks were used and one and one-half cubic yards per load were hauled uniformly. The team wagons were loaded by hand shoveling. The number of shovelers in addition to the teamsters shoveling varied from none for a portion of the time on Job No. 1 to a maximum of two on all of the jobs.

The data obtained from the checkers, together with percentages and averages derived therefrom, have been compiled in the attached table in which are shown for each job and each haul length on each job the following data:

Total loads hauled; average number of teams hauling; average number of loads per team day; load miles per team day; percent. of time dumping; per cent. of time in pit; per cent. of time required for loading at 12 minutes per load; minutes actually used in loading each load; per cent. of time lost in loading; average number of teams at the pit; hauling cost per cubic yard; total loading and hauling cost; contract price, and the hauling cost per cubic yard mile for each length of haul.

From the same table we also find that, providing the time of loading were reduced to 12 minutes per load, the hauling cost per cubic yard mile would be as follows: 0 to ½ mile haul, 43 cents; ½ to 1 mile haul, 27.8 cents; 1 to 1½ mile haul, 23.8 cents; 1½ to 2 mile haul, 22 cents, 2 mile haul and over, 21.5 cents. If the loading time could be reduced to six minutes per load, the hauling cost per cubic yard mile would be further reduced as follows: 0 to ½ mile haul, 34.1 cents; ½ to 1 mile, 24.5 cents; 1 to 1½ mile, 21.7 cents, and above that 21.5 cents per cubic yard mile.

Also, on a 12-minute loading basis the cost per yard for the hauls would be as follows: 0 to ½ mile, 13.5 cents; ½ to 1 mile, 20.5 cents; 1 to 1½ miles, 29.8 cents; 1½ to 2 miles, 38.5 cents 2 plus X miles, 44 cents plus 22X miles.

The data in the table warrants these conclusions, for we find in Job No. 2 on the ½ to 1 mile haul the cost was 22.9 cents, with an 8.7 per cent. loss of time at the pit; on the 1 to 1½ mile haul the cost was 29.4 cents, as compared with 29.8 cents as estimated, while on the 1½ to 2 miles haul of Job No. 3 the cost was 38.4, as compared with the estimated cost of 38.5 cents, and on a 2.95 mile haul the cost was 67 cents, with a 12.3 per cent. loss of time, as compared with the estimated cost of 65 cents.

It would thus appear that efficiency in team hauling and consequent low cost is largely dependent upon, and might easily be secured by, obtaining the maximum efficiency in loading. This problem is by no means as easy as that of the hauling, for many varying conditions are encountered. The total loading and hauling cost on the various jobs was figured to provide for the shovelers actually employed and $5 per day ad-

GRAVEL HAULING COST DATA

	0-½ mi.			½-1 mi.			1-1½ mi.					1½-2 mi.				2-2½ mi.	2½-3 mi.	2.95 mi.
Job No.	1	2	5	1	2	5	1	2	3	4	5	1	3	4	5	3	3	1
Total No. loads hauled	407	475	482	327	1571	364	606	525	898	44	746	312	873	434	198	337	267	714
Average No. teams hauling	7.2	5.2	4.5	9.6	7.0	9.0	6.5	7.6	7.0	6.0	8.7	6.4	7.5	5.2	4.6	8.0	7.2	18.7
Average No. loads per team day	12.1	14.0	9.45	9.75	11.67	7.35	7.0	9.1	7.55	7.33	6.0	5.4	6.93	6.73	5.35	4.6	4.0	3.9
Load miles per team day	4.24	4.62	2.83	7.31	8.75	5.51	8.75	11.38	9.44	9.16	7.50	9.45	12.13	11.78	9.36	10.35	11.00	11.51
Per cent. time dump. (5 min. per load)	10.0	10.9	7.8	8.1	9.7	6.1	5.8	7.6	6.3	6.1	5.0	4.5	5.9	5.6	4.4	3.8	3.3	3.2
Aver. actual time in pit per load	30.6	25.0	46.0	26.6	16.5	46.7	30.7	11.0	24.4	24.5	45.0	36.0	11.5	14.2	37.2	36.0	35.1	30.9
Per cent. actual time in pit per load	61.7	58.3	73.3	43.2	32.0	57.2	35.9	16.7	30.7	32.9	45.0	32.5	13.3	15.9	33.2	27.2	23.4	20.1
Pct. time required loading at 12 m. load	24.2	28.0	18.9	19.5	23.3	14.7	14.0	18.2	15.1	14.7	12.0	10.8	13.9	13.5	10.7	9.2	8.0	7.8
Per cent. of time actually lost in pit	37.5	30.3	54.4	23.7	8.7	42.5	21.9		15.6	18.2	33.0	21.7		2.4	22.5	18.0	15.4	12.3
Average No. of teams at pit	4.5	3.0	3.3	4.1	2.2	5.1	2.3	1.3	2.2	2.0	3.9	2.0	1.0	0.8	1.5	2.2	1.7	3.8
Hauling cost per cu. yd. in cents	21.9	19.0	28.3	27.3	22.9	36.3	38.1	29.4	35.3	36.4	44.4	49.4	38.4	40.0	50.0	58.0	66.7	67.0
Total cost cu. yd. cts. loading and haul	29.9	28.0	38.3	34.3	30.9	46.3	49.1	39.4	47.3	51.4	56.4	66.4	51.4	60.0	75.0	76.0	89.7	76.0
Contract price per cu. yd	45.0	39.0	35.0	60.0	50.0	45.0	70.0	65.0	65.0	60.0	65.0	85.0	80.0	75.0	80.0	107.5	122.5	109.0
Spreading cost per cu. yd	2.00	2.25	3.75	1.75	2.00	2.50	3.75	2.50	3.00	3.75	3.00	5.00	3.25	5.00	6.25	4.50	5.75	2.25
Hauling cost per cu. yd. mile, actual	73.0	57.6	94.3	36.4	30.5	48.4	30.5	23.5	28.2	29.1	35.5	28.2	22.0	22.8	28.5	25.8	24.3	22.7
Haul. cost per cu. yd. mile, 12 min. load	43.0	43.0	43.0	27.8	27.8	27.8	23.8	23.5	23.8	23.8	23.8	22.0	22.0	22.0	22.0	21.2	20.6	21.2
Haul. cost per cu. yd. mile, 6 min. load			34.1	24.5			21.7											
Haul. cost per cu. yd. 12 min. for load		13.5			20.5		29.8						38.5					
Haul. cost per cu. yd. 6 min. for load																		

Above figures based on 25c per hour for man alone and 40c per hour for man and team.

ditional for the general superintendence of a foreman or the contractor. The resulting loading costs vary from 7 cents to 25 cents per yard, the lower figures being too low on account of the teamsters acting as shovelers while waiting to get into the pit, and the highest figures being boosted on account of an excessive amount of frost and firewater and poor supervision. The lowest job average for loading was secured on Job No. 2, it being 9 cents per yard. Favorable pit conditions were a large factor in producing this low figure. It would appear that for average Redwood county pits 10 to 15 cents per cubic yard should cover the item of loading by hand. Whether or not some mechanical loader would be able to reduce this item I am unable to state, but would be interested in learning.

The failure to successfully solve this mechanical loading problem contributed in a large measure toward increasing the figures I am able to present on gravel hauling by tractor.

The tractor hauling outfit used in Redwood county consisted of a 30-60 Holt caterpillar gas tractor and a train of 7 Troy 3½-yard reversible spreader wagons, a 50-yard storage bin and a belt conveyor loader.

Difficulties were encountered from the very start. Considerable time was consumed in erecting the storage bin and loader. When the first train was finally loaded ready to start it was found that the tractor would not pull more than two cars over a short sharp pitch at the railway crossing on the most direct route. After some investigation and experimenting, it was found that four cars could be hauled across private fields to the top of a short pitch about three-fourths of a mile from the pit, and that by doubling back for the remaining three cars a train of five cars could be made up and hauled the remaining distance of two and a quarter miles. One thousand three hundred and sixty-five yards were hauled in this way over an average haul of three miles, or a total of 4,125 cubic yard miles, at the average rate of 129 cubic yard miles per day, which, on a basis of $20 per day to cover the cost of operation, interest and depreciation, was at the rate of 15.4 cents per cubic yard mile for the hauling.

From the next pit they hauled a total of 1,584 cubic yards on to a stretch from 1 to 3.6 miles distant, making a total of 3,422 cubic yard miles. There were no grades greater than 2 per cent. on this stretch, and they made an average of 142 cubic yard miles per day on this work, the cost being 14.1 cents per cubic yard mile. In several days they were able to make as high as 216 cubic yard miles, which would be at the rate of 9.2 cents per cubic yard mile.

From the foregoing it would appear that the cost of hauling by tractor was considerably less than by teams. The advantage in favor of the tractor would have been greater, in my opinion, had there been more power available. A 40-80 tractor would have made a much better showing. Another factor cutting down the capacity of the train was the inability of the loading equipment to supply gravel fast enough. With ample power to pull six cars and a train load of gravel always ready when the train arrived at the pit, there is no doubt that the record of 9.2 cents per cubic yard mile made on a few days could have been maintained thruout the job.

However, in tractor hauling it is essential, as I have suggested, to have a bin full of gravel ready to dump into the cars quickly when the train arrives at the pit, for the outfit cannot make any money while waiting to be loaded. A bin of from 25 to 30 cubic yards capacity must be provided. The bin must be portable, easily transported from pit. This portable feature is essential for the loading apparatus also. Unfortunately, my experience in this instance does not prepare me to tell you what equipment is practicable, but I can tell you that a belt conveyor and a non-portable bin are not practicable, for I've seen them tried, and the cost of tearing down, moving and re-erecting the bin amounted to fully 10 cents per yard of gravel handled. The belt conveyor may be successful on a level grade or a very slight incline, but when it comes to raising the gravel about thirty feet vertically, you have gone beyond the practical range of a belt conveyor. I have no definite data as to the cost of loading with this apparatus, but, as nearly as I can estimate, it was between 25 and 30 cents per yard, which, together with the cost of moving the bin, makes a total loading cost of 35 to 40 cents per yard.

It would seem, with the proper equipment, the total loading cost should not exceed 10 cents per cubic yard. If this is possible, the comparison between tractor and team hauling is very much in favor of the tractor.

Besides the cost, there are other features in favor of the tractor hauling which I wish to point out briefly. First: By applying the gravel in two courses with a tractor you get your gravel rolled without additional cost, and the road is ready for travel as soon as the gravel is applied, instead of a month or more later, as with teams. Second: By loading into a bin, thence to wagons and thence to the road, you obtain an efficient mix of the materials so that instead of having one load with good gravel with a fair amount of binder followed by a load of sand with no binder and the resulting hard bump and chuck hole a few weeks later, you have a gravel of uniform consistency which does not tend to develop waves or chuck holes.

MANAGEMENT OF NEW YORK'S MUNICIPAL FERRIES.

For ten years the city of New York has operated two ferries under municipal ownership, one to Staten Island and one to Brooklyn. The former is practically the only medium of communication regularly, while the latter is a supplement to bridge and tunnel service.

Until two years ago there was much criticism of the management because the ferries were run at a large annual loss. Handsome terminal structures were erected, which were also criticised because of their high cost. The present administration of the department of docks and ferries has been in office nearly three years and has changed the deficit of $289,816 in 1913 to $132,133 in 1914, and a profit of $135,334 in 1915. This profit was made altho there was a decrease in gross earnings of $23,000, because at the same time there was a decrease in operating expenses of nearly $164,000.

No account is made of interest or depreciation in these figures, the beauty and permanence of the public structures and the character and quality of the service being so much more than they would be under private ownership that they are considered to be equivalent in value to the amount of these items.

The reduction in revenues was due to a free transfer agreement with the street railway at the foot of Whitehall street, fare being divided between them, and the arrangement not resulting in the prompt stimulation which was expected. If the city had received the whole fare, its receipts would have been increased about $116,000.

If interest and depreciation are counted, the deficit in 1915 would be nearly $500,000. If the improvement in conditions continues, this deficit will also be wiped out.

The reductions in expense show a saving of $112,000 in fuel, $99,000 in reduction of operating force on the Brooklyn division, $64,000 by removal of repair shops to the Staten Island terminal and omitting accident insurance.

The average number of passengers carried per trip on the Staten Island ferry has increased from 201 in 1906 to 314 in 1915, the maximum carried in one day being 139,446, on July 18, 1915.

CONCRETE ROAD CONSTRUCTION

IN OAKLAND COUNTY, MICHIGAN

By M. De Glopper, County Engineer, Pontiac, Mich.

This is a practical article by the man in charge of the work which goes into detail as to the methods of construction and it will be of great value to the engineer or road superintendent who has the supervision of concrete road construction as well as to the contractor doing the work.

The highway whose construction is here described is on the Woodward Avenue road, so called, being a continuation of Woodward avenue, Detroit, in Oakland county, adjoining Wayne county on the north. The length of highway constructed was: Section 1, 4¼ miles; Section 2, 1 1/3 miles. Average traffic is 1,800 vehicles per day, mostly automobile and motor truck traffic, the latter being very heavy. Funds were secured by direct taxation, the county road rate being two mills, and the valuation of county, $58,000,000.

The dimensions of the cross-section were: Width, 16 feet concrete, 24 feet between shoulder lines; depth, 8 inches in center, 6 inches on sides; rate of crown, ¼ inch per foot.

The unit prices of the accepted bid were as follows:

	Section 1	Section 2
Grading and ditching, per 100 ft.	$ 14.22	$ 20.00
Concrete, per sq. yd.	1.27	1.13
Baker armor plate joints, each	1.67	1.67
4-in. hard-burnt land tile in place, per ft.	.10	.10
12-in. vitrified tile in place, per ft.	.40	.40
Concrete in culverts, bridges, etc., per cu. yd.	6.00	7.00
Reinforcement for bridges in place, per lb.	.03	.03
Catch basins with covers complete, each.	25.00	15.00
Extra work above cost	10%	10%
Total price in lump sum	$59,674.27	$16,355.67

The officers in charge of the work were: John Adams, of Leonard, Thomas Lytle, of Farmington, and Robert Garner, of Pontiac, commissioners, and M. DeGlopper, Pontiac, Mich., engineer.

Drainage—Considerable expense was incurred in laying a tile line along the entire length of the road because of the presence in the highway of a double-track interurban line, reducing the available width to a minimum and prohibiting the construction of adequate open ditches. Besides, the general contour of the ground would not permit satisfactory surface drainage. The tile were laid well below the frost line at an average depth of about 3½ feet, catch basins being included at frequent intervals for diverting the flow into its proper water course. Open grate covers permitted the entrance of all surface water from the shallow gutter above. The pipe joints were partially sealed by a single wrap of tar paper to prevent excessive seepage of earth into the drain.

Grading—The original surface consisted of a well-compacted but worn-out gravel road, the sub-soil varying from a light blow sand to heavy retentive clay. No excessively large cuts or fills were encountered and comparatively all the grading was done by use of scarifiers and graders, followed by a force with picks and shovels to perform the fine grading.

The rolling was continuous across the entire sub-base, care being taken to produce a bottom of uniform hardness in which there would be no variation of bearing power and capillarity. Excessive compacting in the middle or sides was guarded against in an effort to overcome as much as possible the formation of longitudinal cracks due to this variable-bearing factor. Non-uniformity in hardness of the supporting soil offers a great inducement to cracking because of heaving, the concrete having little strength to offset the tensile and shearing stresses set up within it.

Grade stakes were set for both the rough and fine grades in the center and on the sides of the roadway at intervals of 100 feet, the intermediate sections being teed in.

Requirements of the Concrete—Specifications called for a one-course pavement mixed in the following proportions:

American portland cement	1 part
Clean sharp sand	1½ parts
Broken stone or gravel	3 parts

All cement used in the work was required to stand the rigid tests covered under the standard specifications adopted by the Am. Soc. C. E. Inspection service was performed under our direction by the Pittsburg Testing Laboratories of Detroit, at a cost of 3 cents per barrel. Samples were taken from car lots at the mills and results reported on 24-hour and 7-day tests. Complete daily reports were kept by the local inspector on the work and I believe that the additional expense incurred was meritorious in securing the assurance of the use of high-grade materials. The testing service cost approximately $100.00 per mile of road.

The fine aggregate consisted of clean, sharp sand free from loam, clay or other foreign matter and containing voids not to exceed 33 per cent. as determined by saturation. It was graded from fine to coarse, the latter predominating, and all required to pass a ¼-inch screen.

The coarse aggregate consisted of screened washed gravel graded in size from ¼ inch to 1¼ inches and free from clay or vegetable matter.

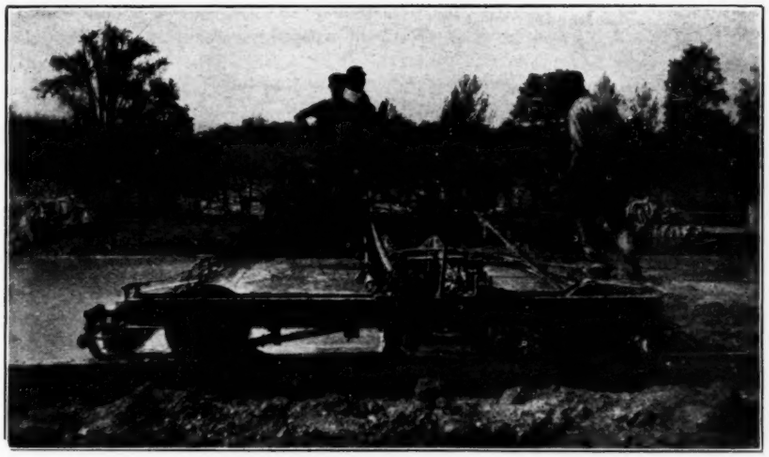
Handling of Materials—The use of bank-run gravel being prohibited, it became necessary to install a combined washing and screening plant. Extreme care was used in the care of the aggregate, removing all possibility of danger from clay coating and fine powdered sand. All gravel was shipped in by rail, no local material being available, and delivered directly in hopper-bottomed cars to the plant. After dumping into a track hopper, having a depth of about 7 feet, the gravel was carried to the hoisting bucket elevator over an apron conveyor. The total lift from hopper to screens was about 27 feet.

The particular plant used, as shown in the illustration, was of the Weller type, equipped with two storage bins for sand and pebbles, having a capacity of 100 tons each. The operating power was furnished by a 5-h.p. motor, the water being pumped thru a 3-inch main having a vertical lift of about 35 feet. Principal, perhaps, among the advantages to be derived from the use of this type of plant, is the possibility of discharging the waste water at the end of the screen at which the gravel enters. With this arrangement, the dirty water never comes in contact with the clean material. Sliding gates in the bottom of the bins admitted easy and rapid loading.

In all probability, no one factor has more influence over successful construction than the factor of the transportation of the material itself. Reliance upon favorable weather conditions has proven disastrous to many contractors. The past season was a particularly bad one, causing the loss of nearly forty actual working days. Under such conditions wagon or tractor haul is an impossibility, resulting invariably in utter

destruction of the sub-base. Traffic in a confined wheelway leaves that portion of the base so compacted that the desired uniform bearing power is impaired and longitudinal cracks are bound to appear. Ruts cut into the road, even if refilled, are never returned to their proper condition, leaving holes for retaining water under the sub-base. What is true of the use of wagons and tractors is equally true of motor trucks and trailers.

There is only one practical method of transporting materials of construction over a sub-base, providing the magnitude of the work warrants its adoption. This method is by use of the narrow-gage industrial railway. With its use, the sub-base is not subjected to any wear, the compacting effect is well distributed, and the weather conditions can well be disregarded. A greater saving in cost and time, delivery of more material in a shorter period on account of increased speed and tonnage capacity, requires less working space and can be used in carrying other materials of construction besides aggregate, etc. These are only a few of the many advantages to be derived.



BAKER FINISHING MACHINE, SHOWING TWO TRUCKS, WHICH RUN ON SIDE RAILS, SUPPORTING OSCILLATING STRIKE, VIBRATING AND COMPRESSING PAN, AS WELL AS FINISHING FLOAT, WHICH EXTENDS FULL WIDTH OF ROADWAY.

On our work, all material is delivered to the job by means of a Koppel hauling outfit, consisting of tracks, engine and cars. The portable rails are mounted on steel ties built up in sections and connected by simple slip shoes. Strong brackets and clutch bolts hold the rails securely to the ties, which are wide enough to distribute thoroly the bearing weight of the load. The gage of rails is 24 inches. The cars, twenty in number, are of the two-way, side-dump, rolling-bearing type, each having a capacity of 1½ yards. No loss of time is experienced in loading or unloading and the material is placed far enough away from the rails to prevent constant derailing. The engine is a standard Koppel dinky, rated at 20-h.p. and weighing about 7 tons. The center of gravity being very low, good tractive results are obtained in pulling heavy loads.

The work performed by the outfit during the past season has been very satisfactory in spite of the fact that conditions were not favorable to low unit costs. The long haul did not exceed 3 miles and the actual operating time of the outfit was consequently reduced. Actual cost of transportation was about 20 cents per yard mile, but this could easily be reduced to 15 cents under favorable conditions.

The aggregate was dumped directly upon the sub-grade, the fine and coarse material being kept separated. The total amount of material delivered per hundred feet was 36 yards of pebbles, 19 yards of sand and 60 barrels of cement.

Side Rails—Just prior to commencement of mixing operations, the side rails are laid to grade, extreme care being taken to get corresponding side rails at the same elevation. The rails are set on stubs driven into the ground at sub-base level and held in place by means of steel pins having eccentric axis. We use only the Baker type of indestructible rail, consisting of 12-foot channel lengths, 6 inches in depth, and having a weight of 8 pounds per linear foot. These rails are particularly well adapted for county road work, and are a distinct improvement over the old type of wooden rail because of their rigidity and easiness to place in position. Connections are made between sections by means of a fish plate securely locked with an eccentric pin.

The old style 2 by 6 plank rails are unwieldly and unreliable. They require stiff bracing to prevent bending and are always more or less open at the joints, permitting the loss of mortar.

Mixing and Placing—The mixer in use on our work is a No. 16 Koehring, having end automatic loading skip. It is fitted with the improved batch meter and regulator, which proved to be considerable of an advantage. The uniformity of the mix was kept quite constant, the length of time specified for each batch to remain in the drum being 45 seconds or equivalent to 12 revolutions.

The sub-base was thoroly sprinkled to prevent loss of moisture and too rapid drying before the initial set had taken place.

The consistency and quality of concrete produced received close attention and every effort was made to procure uniformity. The only variation was that made necessary by an occasional supply of over-sized coarse aggregate. In this case, a small increase in the sand or a corresponding decrease in the stone content was made to prevent danger from not having the voids thoroly filled. No variation should be made in the cement content and with a 1:1½:3 mix better general results will be obtained by keeping the cement and sand constant and varying only the pebble content when absolutely necessary. The attempt was made at all times thoroly to fill the voids and have enough excess mortar to provide for making a top which would be impervious. Excess mortar should never be greater than 10 per cent. A concrete containing just enough mortar to fill the voids cannot be finished properly and seepage will result in localization of the coarse aggregate, leaving exposed stone on the surface, tending to induce pitting and ravelling. Lack of sufficient mortar and dryness always requires retempering, destroying the bonding characteristic of the cement and causing flaking and rapid wear on the surface. A non-uniform consistency or density, allowing variable degrees of stress thruout the mass, will soon result in cracking or perhaps even disintegration.

All the arguments regarding consistency, excess mortar, density, finishing and curing are closely allied with the subject of wet and dry mixes and moisture content. The public impression has always been to construct the road with wide joints to allow free expansion and prevent buckling, a form of rupture that cannot be caused by or attributed to this cause. The subject of moisture content is one very worthy of consideration, altho many authorities still insist on reckoning mainly with temperature changes. It is very doubtful whether the latter evil, with its very small characteristic of elongation and the frictional resistance presence in the sub-base, is worthy of any consideration at all, only in so far that in working in conjunction with the stresses due to moisture content, it may increase liability of fracture. Increase in moisture content, smooth sub-base, conditions allowing free movement, and drain-

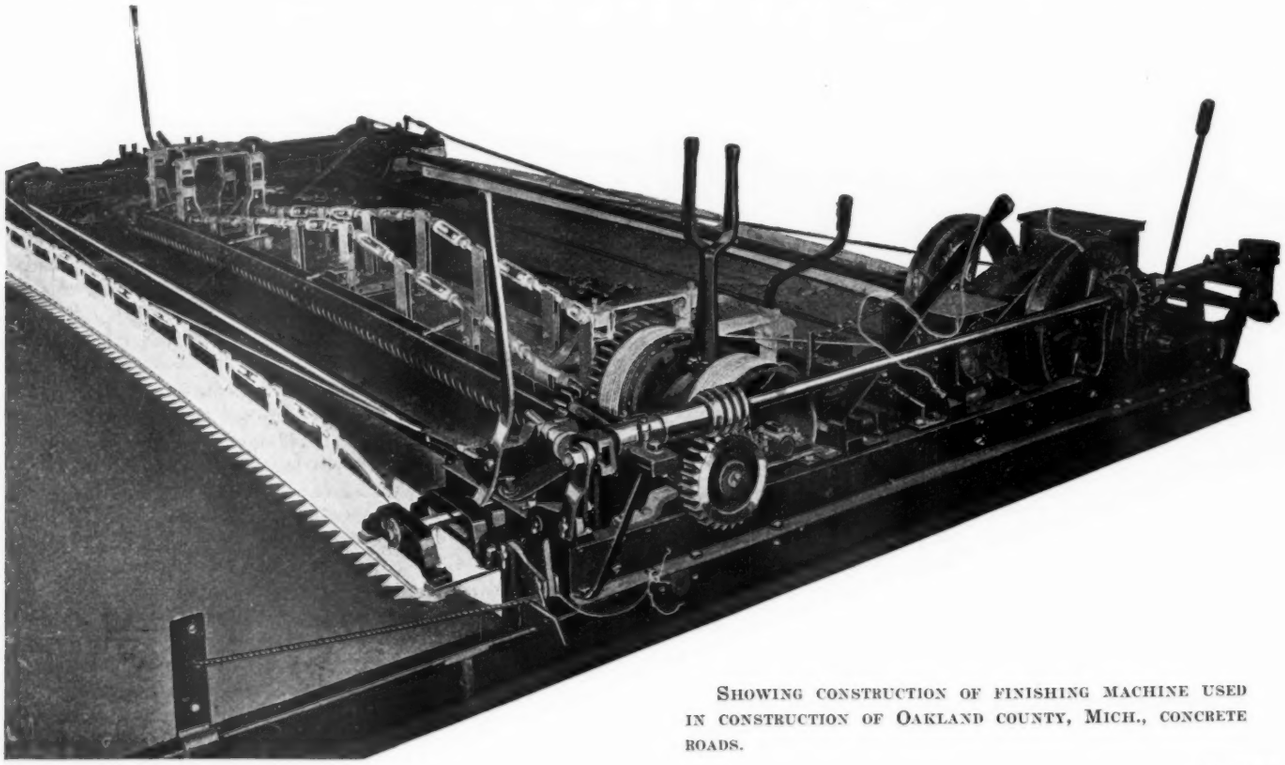
age factors are undoubtedly the causes of practically all of the cracking. I think that if some of the attention which is now being directed towards the concrete itself, was directed, instead, towards producing better and less moisture-retentive sub-grades that better results would follow.

Joints—The subject of expansion and contraction brings us face to face with the matter of joints. Cracks must and will appear in all concrete roads. The question of whether we shall include making them at the time of construction or allow nature to provide them by following the zig-zag line of the least resistance has long ago been decided, at least in sections of the country having as variable a range of temperature as experienced in Michigan. The only question with us is, shall we give our joints the adequate protection due them. For light traffic, perhaps a good felt-filled joint will suffice, but where the roadway is being constantly subjected to heavy shocks this will not be found sufficient. We are using the Baker armor plates with good success. These consist of two plates, 15 feet 6 inches in length and ⅛ inch in thickness, with a strip of tarred felt extending to the bottom of the concrete. The plates are made of a mild steel so beveled on the edges that they will wear evenly with the adjoining concrete. Traffic shocks on the joints are transmitted into the block itself instead of horizontally along the surface where a shearing stress would cause crumbling. The bars are supplied with shear members projecting from, and a part of the bar itself, removing liability of raising or misplacement. The successful use of these joints depends solely upon the care exercised in their installation. We are using the Baker installing device on our work, decreasing to a considerable extent the errors due to carelessness.

Finishing—Perhaps more dissatisfaction has arisen over the manner in which concrete roads have been finished than over any one other detail of the work. The first test given to a road after it is thrown open to the traffic of the public is to determine its smoothness. On this one feature the work is very often either approved or condemned and not always is this determination in error. It cannct be expected that any road finished in a slip-shod manner and containing raised joints and a wavy surface, has received the attention in the other details in accord with good engineering practice. A serious mistake or carelessness in one detail means usually the same exercise of bad judgment in others. The old saying, "a chain is no stronger than its weakest link," can well be adapted to a concrete road. If the sub-base is wrong, the road is bad; if the concrete is not uniform, the road is not strong; if the finishing is bad, the road will not wear properly. What affects the appearance of the road usually affects the construction of the road itself.

The striking and finishing is an operation which calls for the maximum skill on the job, and it is on account of this unreliable factor of human carelessness that so much unsatisfactory work has been put in. But perhaps there is still an opportunity to secure release from this element. The Baker improved automatic finishing machine, now on the market, means much for the advancement of concrete construction. We have used this machine on all of our work and cannot give it too much commendable praise. It is not a new-fangled idea built according to theoretical requirements, but is based upon good practical ideas gained from broad experience in the construction field. It is not complex but is efficient, labor-saving and economical. Its demonstration on our work was thoro. I have received so many inquiries for information concerning the practicability of the machine that perhaps an explanation of its construction and operation will not be amiss in this article.

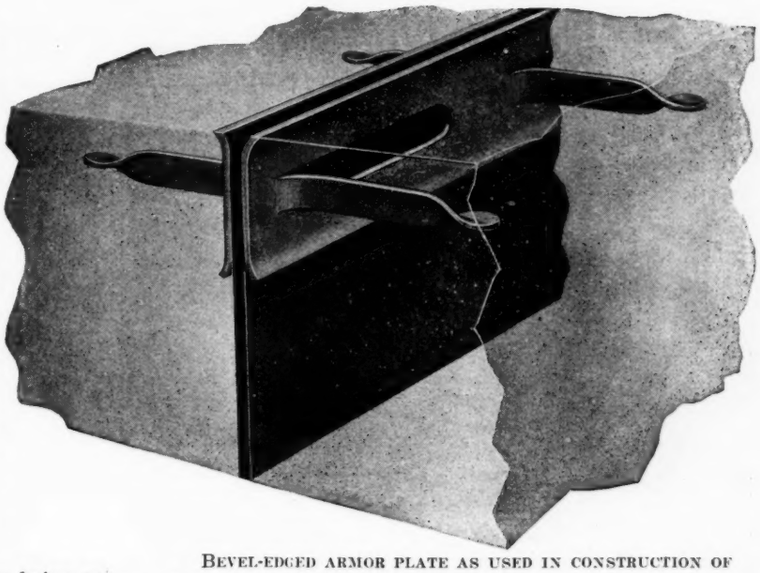
Referring to the illustration, it is noticeable that the machine contains four separate and distinct features, all of which act as a unit on the work. These features are the oscillating strike, the vibrating and compression pan, the agitator, and the finishing float, each of which performs its function in the natural order. The entire mechanism is mounted on two trucks which run on the side rails previously mentioned. Each feature is adjustable to meet different requirements for crown or density. It operates under its own power, a 3-h.p. gasoline engine mounted on one of the trucks transmitting the power necessary to operate the strike, pan and float, and also the power necessary to propel itself along the surface. This for-



SHOWING CONSTRUCTION OF FINISHING MACHINE USED IN CONSTRUCTION OF OAKLAND COUNTY, MICH., CONCRETE ROADS.

ward movement is obtained by tension cables attached to the side rails some distance ahead of the machine and passing over revolving drums on the machine itself. By means of levers, the strike, pan and float may be raised or lowered to decrease or increase the compression and vibration required upon the particular material being finished. After thoro compacting and levelling, the float produces the final finish.

The complete weight of the machine is 3,600 pounds, and the total compressive force upon the concrete may be adjusted to any portion of this weight. With a 1:1½:3 mix, such as is usually used on high-class work, the machine operates best with a compressive weight on the pan of about 2,500 pounds. As the size of the pan itself is 15 feet 6 inches by 22 inches, the compressive pressure per square foot of area is about 85 or 90 pounds neglecting axle friction. With this compression, aided by continual vibration of the pan, a concrete is produced which is of the most uniform density possible to obtain. The discouraging element of repairs is practically removed, there being no intricate mechanism outside of the gasoline engine itself. On the 5½ miles of road we constructed, the precaution was not even taken of keeping a hand float on the job for emergency use.



BEVEL-EDGED ARMOR PLATE AS USED IN CONSTRUCTION OF OAKLAND COUNTY, MICH., CONCRETE ROADS.

Perhaps a better idea of the advantages of this machine can be drawn by means of a comparison between the hand and machine methods of finishing. First, consider the merit and concrete requirements of the old method (hand strike and finish):

1. A very wet and even sloppy consistency of concrete is usually maintained in an attempt to force the filling of the voids. This leaves many weakening invisible pores, increasing the possibility of high moisture content.

2. A very wet mix is necessary to provide sufficient time for tamping, striking and floating before the initial set takes place.

3. The wet mix, when used, produces a wavy surface, especially on grades, the tendency being for the mortar to creep away from the crown to the sides or bottom, leaving a flattening effect. This is contrary to specifications, but is unavoidable with a wet mix. Most specifications require a concrete to be so plastic that it will flush readily under light tamping and at the same time to be so dense that there will be no separation of the mortar from the aggregate. This is inconsistent. One condition or the other must prevail.

4. Hand striking and floating is slow, tedious and expensive work, requiring at least four or five men for this part of the work.

5. Inability to finish the surface as fast as the concrete is placed on the sub-grade very often results in the necessity of retempering the surface for smooth finishing. This retempering, resorted to after the concrete has started to set up, very often destroys the bonding characteristic of the cement and causes rapid wear and dusting on the surface.

6. Hand floating leaves a deceiving surface. It may appear to be smooth, but the presence of numerous small depressions is discernible upon the evaporation of the water. Quite often while the floating is being done, these depressions are replenished with a little additional concrete or mortar. This does not leave a proper bond between the depression already floated and the added material, which is liable to form a crust.

7. In hand tamping, as usually performed in conjunction with the striking, the compressive force can only be applied to a very small surface at a time. As soon as the tamp or strike is raised, the mortar and excess water rush into the depression formed, leaving a surface which is not uniform in consistency.

8. The principal reason for advocating a wet mix is that no tamping will be necessary and consequently the workmen will not be compelled to walk on the concrete. The advocacy also implies that the weight of the material and fluidity of the mortar will furnish the required density.

9. The placing of an excessive amount of concrete results in the riding of the strike and increases the labor in floating and the attending chance for surface waves.

10. To secure satisfactory results, the operation of the strike must be repeated at least two or three times over the entire area.

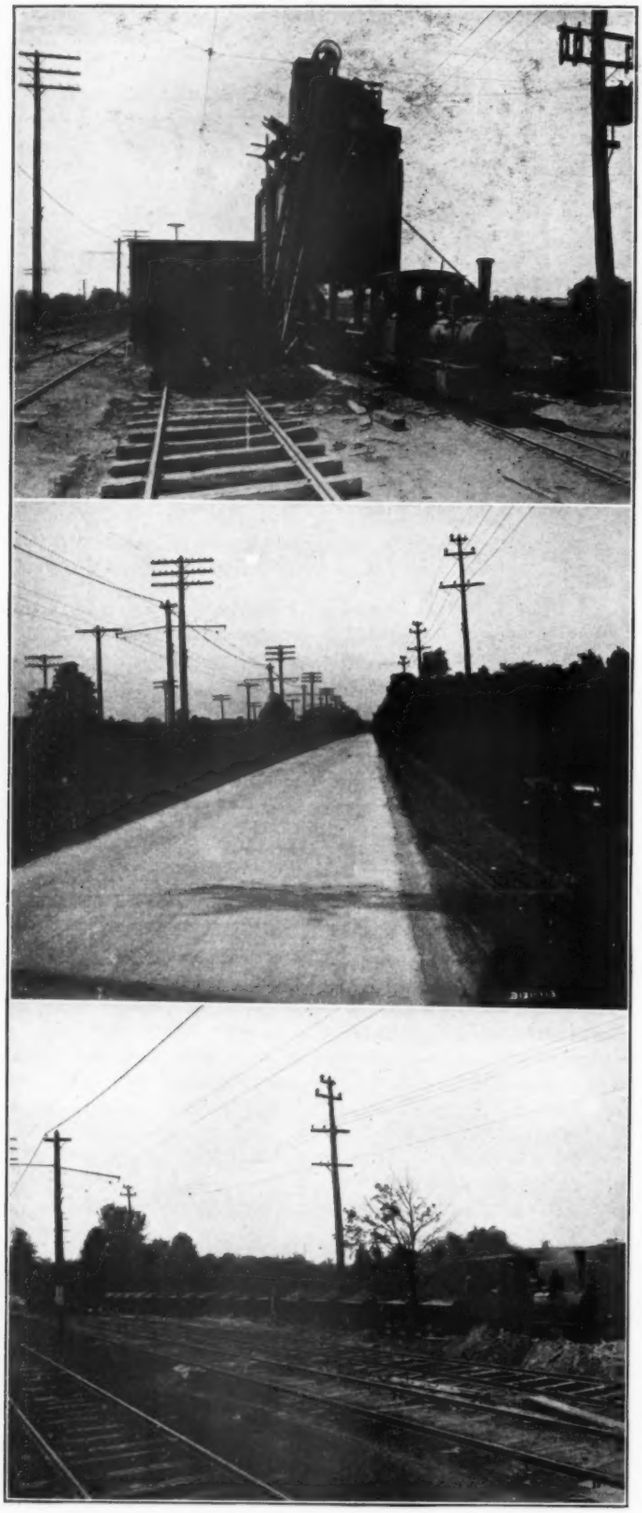
11. The attempt to secure a hard surface is often made at the sacrifice of a true crown, the tendency being to rub the material out until the surface is flat.

Conclusions to be drawn from the abuses of the hand striking and floating method lead in most cases to faults due to the very wet mix used and to the element of human labor. If these conclusions are correct, then why should we refuse to believe that any other method of performing this work, after the two faults mentioned have been removed, is likewise improper? From careful observation, I have drawn the following conclusions on the advantages to be secured by use of a mechanical means of finishing and striking the concrete:

1. It is entirely unnecessary to use a wet mix, in fact, a more dry mix is very advisable. This will greatly increase the ultimate strength of the concrete. The consistency can be

2. It is not necessary to increase the water content to our roads in 30-foot sections between the joints and the total allow sufficient time for striking and floating. We construct maintained uniformly thruout.
time necessary to strike, compress and float each section is 15 minutes. Instead of waiting for the finishers to catch up, the machine is waiting for more concrete. We have only been able to lay 600 linear feet of roadway per day, and consequently do not know what the real capacity for work of the machine would be. However, it is safe to place this figure at from 900 to 1,000 feet per day.

3. Waves in the surface are dispensed with. The strike moves transversely and leaves just enough excess concrete for compression to the final grade. The compression pan is placed at a slight angle to permit a more uniform and gradual compression on the concrete. The material under the pan at all sections receives the vibrated compression for a period of about 1 minute and more if desired. After the pan has passed



WASHING PLANT AND TRAIN, AS USED BY CONTRACTORS ON OAKLAND COUNTY, MICH., CONCRETE ROADS. CENTER VIEW SHOWS COMPLETED PAVEMENT ON WOODWARD AVE., BETWEEN ROYAL OAK AND BIRMINGHAM.

any section there are three noticeable features apparent at once, (a) none of the coarse aggregate is exposed at the surface; (b) there are no collections of water on the surface; (c) just enough excess mortar has been brought to the surface to provide a smooth, strong, impervious covering. The surface is left in an ideal condition for the finishing float which follows. After the completion of the float's work, the appearance of the surface is self-evidence of the completeness of the task. Not a wave in the surface, a perfect crown across the entire width and no exposed aggregate.

4. Compare the cost itself of striking and floating with that involved in the other method. The hand method requires at least four or five men. By the use of the machine, only one attendant is necessary, and it might be added that the only necessary qualification he must possess is a willingness to take an interest in the work. Any man who can operate a gasoline engine can operate a Baker finishing machine.

5. Possibility of speedy work removes the possibility of having to resort to the abuse of retempering.

6. The vibrative compressive force takes place over a wide section and there is no flow of mortar into a section previously compressed.

7. A wet mix dispenses with tamping but weakens the concrete. On a more dry mix the machine produces this tamping, resulting in a very dense concrete, free from practically all air bubbles and seepage voids without a separation of the mortar and aggregate.

8. It is impossible for the machine to ride the concrete, the trucks being fitted with bracket scrapers mounted ahead of the wheels to keep the rails clean. Consequently, there is no tipped effect and the road must be down to the proper grade across the entire cross section.

9. Only one forward operation is necessary for thoro completion of the work. There are no reverse speeds on the machine.

10. The vibration produced is crystalline in effect, leaving a surface that is hard, smooth, dense and impervious. The finished work is practically monolithic in structure.

11. No appreciable time elapses between striking and floating, as occurs in the old method. From the time any section has been subjected to striking until it is floated and completed but 2½ minutes have elapsed.

The machine will do all that is claimed for it and more cannot be expected. Engineers, contractors or road commissioners interested in the advancement of concrete road construction should investigate the merits of this machine from an economic as well as an efficient standpoint. The time is not far distant, perhaps, when its use will be included and called for in first-class specifications. Discontinue trying to specify some of the ambiguous requirements for variable consistency, striking, tamping, finishing from a bridge, retempering, etc., by merely inserting a clause in your specifications: "Machine finish required."

Reinforcement—We believe in the feasibility of using reinforcement in our concrete roads. The concrete is subjected to considerable tensile and shearing stress, occasioned by high moisture content, temperature changes, lack of uniform density, defects in sub-base conditions or drainage difficulties. Regardless of whether the insertion of this fabric in the concrete will prevent all cracks or not, I believe that the precaution taken against their opening up and the disintegration of the material along the cracks, justifies its use. On our work we have been using Kahn mesh, a cold drawn steel fabric. It is endeavored to keep this fabric at a depth of 2 inches from the top surface. Carelessness in placing the steel is the greatest fault to be found with its use. We reinforce only the middle 10 feet of our 16-foot roads, believing that this will take care of practically all the longitudinal cracks without having a bad effect upon the sides caused by heaving of the sub-base. Shortage in funds to meet the cost of the material

necessitated the cutting down on the width desired. If the steel will act as a distributer for tensile stresses set up within the concrete, there will be less liability of fracture due to the subsequent contraction.

Shoulders—No attempt was made during the present season to complete entirely the additional 8 feet of width comprising the shoulders. The material available was not of the most satisfactory nature and it was deemed best to forego completion so that the shoulders would receive the benefit of a winter's settlement. In all probability, it will become necessary within a short time to furnish additional turnout space on each side of the concrete by channelling to a width of 2 feet on each side and refilling with stone or gravel. This will serve to prevent washing along the concrete, forming of ruts and the liability of allowing water to get into the sub-base.

Curing—The curing of the concrete road received due attention. Not later than the morning following the placing of the concrete, the surface is thoroly wetted and it is endeavored to cover same with earth at once. The sprinkling is continued for a period of about 1 week if weather conditions demand. The importance and necessity of keeping the road in a wet condition so as to prevent excessive and rapid shrinkage resulting in high contractive stresses, is recognized, and altho we have endeavored to give this phase of the work all the attention due it, we intend to follow more closely the strict requirements necessary. Roads are kept closed for 21 days.

1916 Outlook—During the season of 1916 we will construct, by contract, an additional 4½ miles of concrete road, forming the last link connecting the cities of Detroit and Pontiac and furnishing a continuous pavement for 25 miles thru a picturesque country. Many of the construction features on this work will require constant attention, due to the rolling grades and soil conditions. Grades as high as 6 per cent. on finished road will be encountered. The work will be executed under contract, the same as during the past season, the award having already been made at a total approximate price of $63,000. Unit prices are higher on this work, the advancement being due to increased cost of materials, heavy grading and scarcity of labor.

New Bridge for Johnstown, Pa.

Johnstown, Franklin boro, the Cambria Steel Company, the Pennsylvania Railroad and the Johnstown Traction Company will share in the payment of the cost of a new overhead bridge across the Conemaugh river which will take the place of the structure which collapsed recently.

The traction company will bear between 50 and 60 per cent. of the entire cost of the new bridge, which cost, it is estimated, will amount to between $175,000 and $200,000. Just what percentage of the balance of the cost each of the other four will pay has not been determined.

The plans drawn by A. B. Curry will be used as the basis for the completed plans of the proposed bridge. Curry's plans call for a concrete structure about 1,000 feet long. It will be an extension of Maple avenue and will cross the river at an angle, touching the Franklin side of the stream about 200 feet above the point where the wrecked bridge touched.

As planned at present it will have three arches. One will be over the Pennsylvania railroad tracks, eliminating the grade crossing which made the other bridge dangerous, and there will be two other arches over the river, the plan being to have one pier in the center of the stream. The top of the arches will be about 60 feet from the river bed, so that there probably will be no trouble in getting the consent of the water supply commission to the building of the bridge.

Franklin boro, the Cambria Steel Company and the Pennsylvania railroad and the traction company have been considering the erection of a bridge for some time, and the collapse of the city's structure brought matters to a head. The city was not consulted before yesterday, as the four parties to the original agreement intended to build the bridge independent of the city's aid.

Preliminary plans for the bridge, by a curious coincidence, were mailed to the water supply commission a few hours before the Maple avenue bridge collapsed.

The plans as submitted, however, probably will be revised. They provide for a 40-foot roadway and 6-foot sidewalks. The additional cost would be about $15,000 or $20,000, and this amount split up among the five will not add materially to any one's share of the cost, but it would insure a bridge which would accommodate the traffic for many years to come.

Durability of Brick Pavements

In a discussion on roads around the Ashokan reservoir before the Municipal Engineers of the City of New York, Alfred D. Flinn, deputy chief engineer of the board of water supply, had the following to say:

"As to the durability of brick. The kind of surface that should be used for the Ashokan roads was investigated in 1911 and 1912. I remember distinctly finding one stretch of old brick road, in West Virginia, near the Ohio boundary—not of the modern paving brick, but an old-fashioned, small brick of fire-clay, laid on sand with little skill, which was and had been for years bearing heavy traffic in a manufacturing district. It was twenty-seven years old and still in good condition. Altho not a perfect pavement, it was a much better road than many a newer pavement of other kinds I have seen in other places. In another town I found a street of vitrified shale paving blocks, which looked remarkably good. I asked if this street had been paved last year. They told me no; that pavement was laid sixteen years ago. It looked nearly perfect. I also found many other well-laid brick pavements in excellent condition after ten or more years of service, in city streets and on country roads. Many persons were found ready to say that a vitrified brick block pavement, well laid, was thoroly good for twenty-five years, except under the very heaviest concentrated city traffic—unless abused by being dug up and improperly replaced.

"Portland cement grout is preferred to a soft filler for the joints of brick paving. Wire-cut lug blocks are preferred to repressed blocks; all the examples I examined showed a more perfect pavement wherever square-edged blocks had been used than where the repressed blocks with rounded edges had been chosen.

"Mr. Thomes spoke of the transverse expansion joints, so called. If any of you go to Kingston, N. Y., and inspect the miles of recently-laid vitrified brick block pavement in that city, you will be able to pick out very readily the transverse expansion joints. Within two or three years after that pavement was laid, the city engineer told me they were distinctly sorry that they had made any such transverse joints, as these joints were the only parts of the pavement giving trouble."

Municipal Improvements for 1916.

What the Cities and Counties of the United States expect to construct during 1916.

THE following tables give estimates of public improvements which will probably be made during the construction season of 1916. They cover the various kinds of street paving, sidewalks, curbs and gutters, sewers and sewage disposal, water works, ornamental street lighting, bridges, garbage disposal, buildings, machinery and supplies. Under the headings of "Miscellaneous Street Improvements" and "Comparisons with Conditions in 1915" will be found much interesting information regarding prospective work and conditions in the business field, more particularly as they affect municipal improvements. The tables are arranged in the following order: Street Paving: Asphalt, p. 146; Aspjhaltic or Bituminous Concrete or Macadam, p. 146; Bitulithic, p. 147; Brick, p. 147; Concrete, p. 148; Concrete with Bituminous Top, p. 148; Granite or Sandstone, p. 148; Gravel Streets and Roads, p. 149; Oiled Streets or Roads, p. 149; Wood Block, p. 150; Miscellaneous Street Improvements, p. 150. Sidewalks, p. 150. Curb and Gutter, p. 151. Sewers and Sewage Disposal, p. 153. Water Works, p. 154. Ornamental Street Lighting, p. 155. Bridges, p. 156. Garbage Disposal Plants, p. 157. Public Buildings and Other Structures, p. 157. Machinery and Supplies tobe Purchased, p. 157. Comparison With Conditions in 1915, p. 157.

It will be noted that many cities are not included in these tables. This is due to three causes: Among the larger cities many have not yet laid out their work for the year, so that they are unable to make any reasonable approach to an accurate estimate; among the smaller cities, elections are largely held in the spring months and the year's program is not made out until the appropriations are made and the ordinances are passed by the new councils, late in March, in April, May, and even as late as June; there is this year a larger number than usual of the small cities which expect to do no work, either because prices are high or general business conditions are not yet sufficiently promising, or they have done so much in recent years that they must stop to take breath before starting anything new.

It is worth while to publish this advance estimate because it is made by the men on the ground in each city and gives an early idea of what is in prospect, even if it does not include every city or all the work which will be done in those listed.

Following is an explanation of the abbreviations used in the list:

a—Choice of material not yet made. b—Paid for with bonds. c—Work done by contract. co—County. c. y.—Cubic yard. d—concrete curb. e—Flagstone walks. f—Linear feet. g—Constructed by the state. h—Ctone curb. i—Brick sewers. j—Concrete sewers. k—House connections. l—Contract let. m—Work done by city by day labor. p—Paid by property owners. r—Riveted steel water mains. s—Will be let this spring or summer. v—Vitrified segment block sewers. w—Wooden water pipe. x—Segment block.

STREET PAVEMENTS—1916.

ASPHALT.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
California—				
Anaheim		66,000	c	4-15
Petaluma		3,000	m	
Santa Rosa		4,000	m	
Idaho—				
Moscow		25,000a	c	4-15
Illinois—				
Berwyn	158,400	88,000	c	
Moline	101,176	36,000	c	4-1-15
Oak Park	7,045	2,550	c	
Indiana—				
Anderson		18,000	c	3-20
Bluffton		12,000	m	
Gary		20,000	..	
Goshen		36,000a	..	
Laporte		40,000	c	
Logansport		17,000a	..	
Muncie		23,862a	..	
Richmond		12,000	c	3 or 4
South Bend		140,262a	c	
Wabash		6,000	c	5-1
Iowa—				
Centerville		30,000a	c	
Cherokee		90,000a	c	
Creston		60,000a	c	
Forest City		25,000a	c	
Marion		70,000a	c	
Mason City	p	16,000	c	2-28
Perry		30,000a	c	
Sioux City		10,000	c	
Spencer	75,000	40,000	c	2-23
Storm Lake	10 Sts.	a	c	
Kentucky—				
Louisville		25,690	c	2-23
Maysville		6,000	c	3-—
Louisiana—				
Shreveport	18,500	8,000	c	
Michigan—				
Ann Arbor		15,000a	c	4 or 5
Detroit		10,000	m	
Flint	250,000	125,000	m	
Flint	3,500	1,500	m	
Jackson		19,187a	c	
Minnesota—				
Mankato		10,000	c	4-—
Mississippi—				
Vicksburg		9,164a	..	
Missouri—				
Centerville		75,000	c	
Independence		60,000	c	
Kansas City		30,000	..	
Nebraska—				
College View		15,000	c	6-—
Hastings		173,900a	c	
Lincoln		10,000	..	3-1
Seward		30,000a	c	4 or 5
University Pl.		some	..	
New Jersey—				
Bayonne		36,000	c	
Dover		20,000	c	5-1
Elizabeth	50,000		c	
Jersey City		8,500	c	
Passaic		35,000	c	
New York—				
Buffalo		270,000	c	
Lockport	1,000		c	
Schenectady		50,000	c	
North Carolina—				
Burlington	50,000	25,000	c	3-9
Gastonia		40,000	c	
Greensboro	30,000	20,000	c	
Wilson		70,000	c	3-—
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Conneaut	31.320	15,200	c	
Dayton	35,200	12,790	c	4 and 5
Lakewood		100,000d	..	
Lima		17,400	c	
Middletown		7,335d	c	5 or 6
Urbana		18,000	c	
Oregon—				
Astoria		40,000d	c	5 and 6
Eugene	Some.			
Portland	82,827	33,458	c	
Pennsylvania—				
Scranton	67,340	25,847	c	3
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000d	..	
Sioux Falls		100,000d	..	
Utah—				
Ogden		24,000	..	
Washington—				
Walla Walla	200,000	100,000d	c	
Wisconsin—				
Beloit		100,000d	..	
Madison		38,600	c	
Manitowoc	25,000	13,000	c	
Marshfield		30,892d	c	
So. Milwaukee		11,500d	c	
CANADA—				
Ontario—				
Hamilton		30,000	..	
Ottawa	250,000	80,000	c	4

ASPHALTIC OR BITUMINOUS CONCRETE OR MACADAM.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Phoenix		200,000a	..	
Arkansas—				
Hot Springs	18,000	23,715	c	1
Jonesboro	200,000	100,000	c	4-15
California—				
Hermosa Beach	p	25,000	c	
Marysville		17,960	c	
Petaluma		10,000	c	4 or 5
Richmond		20,000	c	
Santa Rosa		16,000	c	
Turlock		5,775	c	
Vallejo	p	20,000	c	5-1
Venice		30,000	..	
Connecticut—				
Danbury	7,400	6,700	..	
Danbury	16,200	16,200	..	
East Hartford		15,000	c	
Putnam		3,000	m	
Wethersfield	2,000		m	
Delaware—				
Milford		5,000	m	
Illinois—				
Chicago Hgts.		47,000	c	3-—
Elgin		50,690	c	
Freeport	10,000	8,000	c	5-—
Hinsdale		5,000	..	5-15
LaGrange		20,000	..	
Marion		10,000	c	5-—
Naperville		60,000	c	6-1
Oak Park	533,539	193,500	c	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Indiana—				
Bluffton		2 mi.	c	3-8
Crown Point	p	10,000	c	
Frankfort		4,600	c	
Gary		10,000	..	
Goshen		36,000	..	
Logansport		17,000a	c	
Marion		10,000	m	
Princeton		12,000	c	
Richmond		1,000	m	
South Bend		140,262a	c	
Wabash		11,000	c	5-1
W. Lafayette		10,000a	c	
Iowa—				
Centerville		30,000a	c	
Greenfield		18,000	c	
Storm Lake	10 Sts.	a	c	
Kansas—				
Great Bend		30,000	..	
Iola		7,000	c	4-—
McPherson		35,000	c	4-1
Osawatomie	4,550	5,000	c	
Pittsburg		29,000	c	
Topeka		65,000	c	2-29
Wellington	87,700	63,120	c	
Kentucky—				
Ft. Thomas		11,000	c	
Maine—				
Lewiston		6,000	m	
Maryland—				
Frederick		13,220	m	
Massachusetts—				
Brookline		50,000	..	
Greenfield		5,000	..	
Lawrence	Some.			
Manchester	29,000		..	
Needham	6,000	10,000	m	
Norwood	16,000	17,000	..	
Revere	20,000	20,000	c	4 to 9
Michigan—				
Battle Creek		50,000	c	
Detroit		10,000	c	
Eaton Rapids	17,000	16,000	c	
Jackson		5,577	c	
Ludington	30,000	20,000	m	
Sault Ste Marie		6,000	m	
Minnesota—				
Mankato		10,000	c	4-—
St. Cloud		17,000a	c	3-7
St. Paul		90,769	..	
Mississippi—				
Starkville		15,960	c	
Missouri—				
Clayton		2mi a	co	
Columbia		677	c	
Columbia		11,679	c	4-15
Kansas City		190,000	c	
Montana—				
Miles City		30,000a	c	
New Jersey—				
Bayonne		5,300	c	
Bloomfield		2,500	c	2-21
Elizabeth	100,000		c	
Irvington		8,000	c	
Passaic		5,000	c	s
Rutherford	13,000	10,535	c	4-—
Westfield		7,500	c	3-20
New Mexico—				
Raton		28,000	..	
New York—				
Dolgeville	Some.			
Geneva		10,000	m	
Gloversville		10,000	c	5-1
Gouverneur	3,000	7,000	m	
Hudson	42,400	26,050	c	
Johnstown	2,000	2,000	m	
Newark		4,000	c	
Plattsburg		5,000	m	
Salamanca		10,000	c	
Utica	144,000d		..	
North Carolina—				
Asheville		15,000	c	4
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Lakewood		100,000d	..	
Lorain		26,000	c	4-15
Norwood		10,000	c	3-—
Oregon—				
The Dalles		4,080	m	
Eugene	Some.			
Klamath Falls		½ mi.	..	
Portland	71,432	39,705	c	
Pennsylvania—				
Carbondale		3,000	c	
Carlisle		10,000d	..	
Freeland	3,000	4,700	m	
Morrisville	201		..	
Norristown		3,000	m	
Northampton	4,235	2,420	c	2-18
Northampton	4,000	3,565	m	
Scranton	2,430	1,620	c	3-—
Waynesboro		15,000	m	
Rhode Island—				
Woonsocket	43,650		m	
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000	..	
Mitchell		27,086	c	2-10
Sioux Falls		100,000d	..	
Yankton		80,000d	..	
Texas—				
McKinney	70,000	46,000	..	3 or 4
Virginia—				
Farmville		2,700	m	
Staunton		8,000	m	
Washington—				
Vancouver	250		m	
Walla Walla	200,000	100,000	c	
West Virginia—				
Charleston	117,647	63,366	c	
Wisconsin—				
Baraboo		8,000	m	
Lake Geneva		2,000	..	
Madison		13,260	c	
Waukesha	15,000	11,000	c	3-30
CANADA—				
Ontario—				
Ottawa		15,000	m	
Stratford		5,000	m	
Stratford		8,000	c	

BITULITHIC.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Phoenix		200,000a	..	
California—				
Richmond		10,000	c	
Indiana—				
Goshen		36,000a	..	
South Bend		140,262a	..	
Iowa—				
Centerville		30,000a	..	
Storm Lake	10 Sts	a	c	
Kansas—				
Rosedale		40,000	c	
Kentucky—				
Ludlow		20,000	c	
Massachusetts—				
Brookline		10,000	..	
Lawrence	Some.			
Manchester	10,000		c	
Minnesota—				
Hibbing	15,000	4,500	c	
St. Cloud		36,000a	c	3-7
St. Cloud		17,000a	c	3-7
Virginia		25,000a	c	
Montana—				
Bozeman		20,000	c	
Livingston		5,400	c	2-21
Miles City		30,000a	c	
New York—				
Herkimer	20,000	8,000	c	6-—
Utica	144,000d		..	
North Carolina—				
Wilson		15,000	c	3-—
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Lakewood		100,000d	..	
Oregon—				
Portland	261,599	103,904	c	
Portland	5,041	2,564	gravel	
South Carolina—				
Sumter		6-7 mi.d	..	
South Dakota—				
Huron		30,000d	..	
Sioux Falls		36,000	c	
Sioux Falls		100,000d	..	
Yankton		80,000d	..	
CANADA—				
Ontario—				
St. Catharines	19,000	7,200	c	

BRICK.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Colorado—				
Ft. Collins		1,545	c	3-10
Connecticut—				
Bristol	30,000	14,000	c	s
Florida—				
Live Oak		13,000a	c	
Sanford	150,000	80,000	c	
Idaho—				
Blackfoot		50,000a	c	
Illinois—				
Alton	p	75,000	c	4-—
Chicago Hgts.		70,000	c	s
Danville		45,800	c	
E. Moline	35,274	15,683	c	3-—
Elgin		72,158	c	
Galva		15,125	c	
Freefort	74,000	30,000	c	5-—
Lake Forest	50,785	16,700	c	
Lawrenceville		9,000a	..	
Marion		25,000	c	4-—
Marshall		22,416	c	4-1
Mattoon		31,500	c	5-—
Moline	21,381	7,519	c	4-15-30
Murphysboro		12,000	c	
Paris		4,600	c	
Pontiac	14,550	7,350	c	5-1
Rockford		52,000	c	4-—
Shelbyville		2,700	c	
Indiana—				
Bluffton		1 mi.	c	3-8
Brazil	10,400	7,920	c	
Crawfordsville		6,700	c	
Frankfort		9,400	c	
Gary		15,000	..	
Goshen		36,000a	..	
Logansport		17,000a	..	
Noblesville		1,980	..	
Portland		7,500	c	3-6
Richmond		12,000	c	3 or 4
Union City		14,000	c	3-—
Warsaw		12,000	c	
Iowa—				
Anamosa		1 mi.	..	
Burlington		4,500	c	4-1
Centerville		30,000a	c	
Council Bluffs	36,317p	17,294	c	
Clinton		22,000	..	
Davenport		15,000	..	
Ft. Madison		20,920	c	3-1
Manchester—Probably 4 or 5 blocks.				
Missouri Valley	100,000p	43,820	c	1-—
Pella		33,000	c	
Perry		30,000a	c	
Kansas—				
Arkansas City		35,000	c	
Atchison		7,500	c	3-6
Council Grove		19,500	c	
Dodge City		8,500	c	4-—
Fredonia		20,000	c	
Holton		10,000	c	2-21
Hutchison		50,000	c	
Iola		8,000	c	4-—
Lawrence		14,000	..	
Lyons		11,000	c	2-25
Lyons		25,000	c	s
Minneapolis		19,043	c	
Neodesha		30,000	c	s
Ottawa		9,370	c	
Pittsburg		19,000	c	3-1
Topeka		46,000	c	2-29
Kentucky				
Louisville		26,677	c	2 and 3
Louisville		11,100	m	
Maysville		26,000	c	3-—
Louisiana—				
Shreveport	26,500	12,000	c	
Massachusetts—				
Greenfield	3,000	4,000	m	
Michigan—				
Battle Creek		8,000	m	
Flint	20,000	9,000	m	
Holland		2,000	m	
Jackson		19,187a	c	
Jackson		8,151	c	
Minnesota—				
St. Paul		5,572	..	
Virginia—10 blocks of alleys—a.				
Mississippi—				
Vicksburg		9,164a	..	
Missouri—				
Clayton		2mi a	co	
Fulton		3,000	c	
Kansas City		45,000	..	
Lexington		6,000	..	
Sedalia		50,000	c	
Warrensburg		6,000	c	f
6Nebraska—				
Havelock		1 mi.	c	
Lincoln		25,000	c	s
Nebraska City—Some contemplated.				
University Place—Some.				
New Jersey—				
Dover		2,000	..	
Elizabeth	25,000		c	
Ridgewood	35,000	17,000	c	
New York—				
Albion		10,000	..	5-—
Buffalo		50,000	c	
Dolgeville	Some.			
Elmira		18,412	c	2-24
Fulton	20,000	7,200	c	4-1
Hudson	5,000	2,035	m	
Jamestown		50,000	m	
Oneonta		500	m	
Oswego	60,000	24,000	c	5-1
Plattsburg		600	c	
Rensselaer		12,600	..	
Wellsville—Small amount.				
North Carolina—				
Wilson		15,000d	c	
North Dakota—				
Fargo		90,000d	..	
Ohio—				
Bucyrus		100,000	c	
Chillicothe		11,000	c	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Cuyahoga Falls	.....	24,000	c	.....
Dayton	25,300	115,180	c	4 and 5
Fayette	.....	7,000	c	5-1
Fostoria	24,000	9,000	c	.....
Franklin	.....	10,000	c	6-1
Lakewood	.....	100,000d	..	.....
Lancaster	.....	16,800	..	.....
Lima	.....	80,000	c	.....
Lorain	.....	8,000	c	4-15
Marietta	28,869	14,913	c	.....
Middeport	.....	50,416	c	.....
Middletown	.....	7,335d	c	5 or 6
Newark	.....	25,000	c	4-1
Niles	.....	25,000	c	.....
Norwood	.....	25,000	c	4—
Painesville	48,000	20,600	c	.....
Ravenna	.....	9,000	c	.....
Steubenville	25,000	12,000	c	5
Toronto	.....	9,087	c	5
Urbana	.....	18,000	c	.....
Wapakoneta	.....	9,000	c	.....
W. Carrollton	.....	10,000	c	6-1
Oklahoma—				
Okmulgee	.....	50,000	c	.....
Oregon—				
Astoria	.....	40,000d	c	5 and 6
Portland	35,450	11,212	c	.....
Pennsylvania—				
Altoona	.....	11,000	c	7—
Bloomsburg	.....	12,000	..	.....
Carbondale	.....	25,000	c	s
Carlisle	.....	8,000	m	.....
Elwood City	.....	3,500	c	5
Franklin	28,800	13,000	..	.....
Freeport	.....	7,000	c	6
Irwin	.....	10,000	..	.....
McKees Rocks—Some.				
Meadville	6,000	4,000	m	.....
Norristown	.....	13,000	..	4—
N. Braddock	.....	11,000	..	.....
N. East	.....	35,000	..	.....
Oil City	.....	1,800	c	.....
Portage	Some.			
Punxsutawney	.....	2,500	..	.....
Scottdale	5,000	3,150	m	.....
South Carolina—				
Sumter	.....	6-7 mi.d	..	.....
South Dakota—				
Huron	.....	30,000d	..	.....
Texas—				
Longview	6,000	2,500	c	.....
Virginia—				
Staunton	.....	1,000	m	.....
West Virginia—				
Charleston	11,904	6,157	c	.....
Moundsville	.....	9,000	c	9-1
Parkersburg	82,776	37,270	c	3-1
Wisconsin—				
Appleton	.....	10,000	..	3-24
Beloit	.....	100,000d	..	.....
Chippewa Falls	.....	3,300	c	.....
Janesville	Some.			
LaCrosse	.....	10,000	c	.....
Manitowoc	36,000	16,000	c	.....
Marshfield	.....	30,892d	c	.....
Racine	.....	54,521	c	.....
S. Milwaukee	.....	11,500d	c	.....
CANADA—				
Ontario—				
Hamilton	.....	500	..	.....
St. Catharines	7,500	2,350	c	.....

CONCRETE.

Arizona—				
Nogales	.....	30,000	m	.....
Phoenix	.....	200,000a	..	.....
Arkansas—				
Wynne	.....	17m	..	.....
California—				
Colusa	17,000	3,000	c	.....
Redondo Beach	.....	45,200	c	5-1
Richmond	.....	50,000	..	5—
Colorado—				
Ft. Collins	p	21,000	c	3-10
Longmont	b	16,000	c	6-1
Connecticut—				
Danbury	4,000	4,000	..	.....
Essex	g	0.25m	..	.....
Greenwich	100,000	53,000	c	4—
Manchester	.....	8,880	c	g
New Canaan	.....	9,000	c	s
Southington	.....	20,000a	..	s
S. Norwalk	15,000	12,000	m	.....
Florida—				
Sanford	5,000	2,500	c	.....
Georgia—				
Athens	12,000	10,000	m	.....
Macon	.....	90,000	c	.....
Illinois—				
Belleville	.....	124,000	c	.....
Berwyn	27,302	14,820	c	.....
E. Moline	.....	4,000	..	.....
Lake Forest	30,672	13,700	c	.....
Lawrenceville	.....	9,000a	..	.....
Marion—County will spend $175,000 on concrete roads.				
Oak Park	7,796	4,000	c	.....
Salem	.....	100 mi.a	..	.....
Indiana—				
Gary	.....	3,000	..	.....
Huntington	.....	600	..	4-15
Logansport	.....	17,000a	c	.....
Muncie	.....	23,862a	..	.....
Noblesville	.....	12,600	..	.....
Richmond	.....	10,000	..	3 or 4
Seymour	.....	3 mi.	..	.....
Tipton	Some.			
Tipton—About 7 miles of county road may be let about middle of summer.				
W. Lafayette	.....	10,000a	c	.....
Iowa—				
Anamosa	.....	20,000	c	6-1
Burlington	.....	5,100	c	4-1
Cherokee	.....	90,000a	c	.....
Council Bluffs	37,983p	25,771	c	.....
Ft. Madison	.....	18,040	c	3-1
Mason City	.....	50,000	c	3-13
Perry	.....	30,000a	c	.....
Sioux City	.....	250,000	c	4 to 8
Spencer	4,000	3,000	c	2-23
Storm Lake	10 Sts.	a	c	.....
Kansas—				
Atchison	.....	6,500	c	3-6
Fredonia	.....	15,000	c	.....
Lawrence	.....	2,000	c	.....
Rosedale	.....	10,000	c	.....
Kentucky—				
Ft. Thomas	.....	20,000	c	.....
Pikeville—Pike county will vote a $500,000 bond issue May 6, to construct 100 miles of concrete and macadam roads.				
Louisiana—				
Kentwood—Perhaps a little.				
Maryland—				
Frederick	.....	13,220	m	.....
Michigan—				
Alpena	.....	15,000	m	.....
Calumet	.....	3,500	c	5—
Greenville	$5,000	.....	c	.....
Hastings	$26,916	17,278	m	.....
Saugatuck—Will pave main portion of village with concrete.				
Sault Ste. Marie	.....	3,000	c	6—
Minnesota—				
Albert Lea	.....	20,000	c	.....
Bemidji	.....	15,000	c	5-1
Cloquet	.....	4,000	c	.....
St. Cloud	.....	17,000a	c	3-7
Stillwater—One block.				
Virginia	.....	25,000a	c	.....
Virginia—Ten blocks of alleys, a.				
Missouri—				
Clayton	alleys	3,160	c	.....
Kansas City	.....	275,000	..	.....
Liberty	.....	15,000	c	.....
Sedalia	.....	20,000	c	.....
Montana—				
Miles City	.....	7,000	c	.....
Nebraska—				
Nebraska City—Some contemplated.				
Red Cloud	2,000	220	c	6—
New Jersey—				
Crawford	$35,000	18,000	c	3—
Glen Ridge	.....	2,000	m	s
Rahway	.....	4,800	..	.....
New York—				
Ellensville	4,000	3,000	c	5
Glens Falls	.....	5,300	c	.....
North Carolina—				
Asheville	.....	15,000	c	4—
North Dakota—				
Fargo	.....	90,000d	..	.....
Ohio—				
Chicago Jct	16,635	12,300	c	2-28
Coshocton	.....	3,000	c	.....
Dayton	10,800	7,000	c	4 and 5
Delaware	.....	11,000	c	.....
Fostoria	4,500	2,600	c	.....
Middletown	.....	34,175	c	5
Oklahoma—				
Bartlesville	.....	17,000	c	4
Oregon—				
Astoria	.....	40,000d	c	5 and 6
Portland	59,629	21,954	c	.....
Salem	.....	10,280	..	.....
Pennsylvania—				
Carlisle	.....	2,200	m	.....
Farrell	40,000	.....	c	.....
Morrisville	489	388	..	.....
Northampton	8,000	5,340	c	2-18
Renovo	.....	2,400	..	.....
Rhode Island—				
Woonsocket	$9,940	.....	c	.....
South Carolina—				
Sumter	.....	6 or 7 mi d	..	.....
South Dakota—				
Huron	.....	30,000d	..	.....
Lead	$6,673	3,178	c	.....
Mitchell	.....	4,758	c	2-10
Sioux Falls	.....	3,000	c	.....
Sioux Falls	.....	100,000	c	.....
Yankton	.....	80,000	c	4—
Tennessee—				
Bristol	.....	30,000	m	.....
Newport	$5,000	.....	..	.....
Utah—				
Ogden	.....	24,000	c	.....
Provo—Some.				
Vermont—				
Proctor	$2,000	.....	..	.....
Randolph	$1,000	.....	m	.....
Washington—				
Chehalis	$15,000	7,500	m	.....
West Virginia—				
Parkersburg	$45,006	24,898	c	3-1
Wisconsin—				
Beloit	.....	100,000d	..	.....
Chippewa Falls	.....	1,500	c	.....
Janesville—Some d.				
Lake Geneva—Some.				
Madison	.....	5,830	c	.....
Marshfield	.....	30,892d	c	.....
Menasha	.....	25,000	..	.....
Neenah	.....	25,000	..	.....
S. Milwaukee	.....	11,500d	c	.....
W. Allis	.....	17,550	c	.....
Canada—				
Ontario—				
St. Catharines	15,500	8,750	c	.....

CONCRETE WITH BITUMINOUS TOP.

Arizona—				
Phoenix	.....	200,000a	..	.....
California—				
Antioch	.....	41,500	c	3—
Hermosa Beach	p	16,000	c	.....
Hollister	.....	24,195	c	.....
Oakdale	p	1,005	c	3—
Pittsburg—Some.				
Placerville	.....	20,249	m	4—
Placerville	.....	4,533	c	.....
Richmond	.....	20,000	c	5—
Santa Ana	.....	7,000	c	.....
Vallejo	p	20,000	c	4-1
Visalia	p	40,000	c	3-13
Illinois—				
Lake Forest	13,168	5,526	c	.....
Iowa—				
Washington	.....	5,642	c	.....
Kansas—				
Abilene	$40,000	25,000	c	.....
Great Bend	$20,000	56,000	c	.....
Michigan—				
Sault Ste. Marie	.....	17,360	c	6—
Minnesota—				
Sauk Center	.....	2,000	c	.....
Missouri—				
Poplar Bluff	.....	30,000	c	.....
Sedalia	.....	10,000	c	.....
Webster Grove	.....	5 mi.	..	.....
New Jersey—				
Bloomfield	.....	40,000	..	4 or 5
Irvington	.....	8,000	c	3-22
Jersey City	.....	50,000	c	.....
Newark—10,000 sq. yds. in Milburn twp.				
Ridgewood	$1,000	.....	m	.....
Wenonah	$77,000	48,000	c	4-1
North Carolina—				
Greensboro	20,000	15,000	m	.....
Ohio—				
Lima	.....	20,000	c	.....
Middletown	.....	7,335d	c	5 or 6
Oregon—				
Astoria	.....	40,000d	c	5 and 6
Coquille	.....	2,570	c	.....
Eugene—Some.				
Portland	20,279	9,745	c	.....
Pennsylvania—				
Bethlehem	.....	45,000	c	.....
McKees Rocks.	.....	2,500	..	.....
Norristown	.....	2,500	m	.....
Tennessee—				
Dyersburg	.....	25,000	c	.....
Texas—				
Paris	$50,000	20,000	c	.....
Waxahachie	.....	10,000	c	.....
Wisconsin—				
Eau Claire	15,000	.....	m	.....
La Crosse	10,000	.....	..	.....
Marshfield	.....	30,892d	c	.....

GRANITE OR SANDSTONE.

Connecticut—				
Danbury	$2,500	2,500	m	.....
Derby	2,000	860	c	.....
Willimantic	5,000	1,800	..	.....

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Idaho—				
Blackfoot		50,000a	..	
Kentucky—				
Louisville		4,880	c	2-23
Massachusetts—				
Lawrence—Some.				
Manchester	$4,100	1,250	..	3-6
Norwood	$40,000	12,000	..	
Revere	$6,000	2,000	c	5-1
Minnesota—				
St. Cloud		36,000a	c	3-7
Missouri—				
Kansas City		10,000	..	
New Jersey—				
Bayonne		9,700	c	
Elizabeth	150,000		c	
Jersey City		43,000	c	
New York—				
Albion		5,000	c	5-—
Buffalo		10,000	c	
Plattsburg		1,500	c	
Rensselaer		400	..	
North Carolina—				
Wilson		15,000d	c	
Ohio—				
Dayton	40,000	12,675	c	4 and 5
Norwood		32,000	c	4—
Oregon—				
Portland	32,814	8,355	c	
Pennsylvania—				
Carbondale		2,000	c	s
Gilberton		25,000	m	
McKees Rocks—Small quantity.				
Scranton	19,505	7,232	c	3—
Rhode Island—				
Woonsocket	$163,797		c	
South Dakota—				
Sioux Falls		16,000	c	
Wisconsin—				
Appleton		3,000	..	4-1
Madison		285	c	

GRAVEL STREETS AND ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arizona—				
Nogales		17,000	c	
Arkansas—				
De Queen		28 mi.	..	
Paragould	b	15,000	c	
California—				
Colusa	$2,000	3,000	c	
Redondo Beach		3,111	c	
Colorado—				
Colorado Sp'ngs		100,000	m	
Durango		1 mi.	m	
Ft. Collins	p	25,500	..	
Longmont		5,000	m	
Connecticut—				
Norwalk	$10,000		m	
Indiana—				
Lafayette		12,000	c	4 and 5
Kansas—				
Fredonia		3,000	c	
Weir	$4,000		c	
Louisiana—				
Kentwood—Little but repairs by city.				
Patterson	$900	2,400	m	
Maine—				
Lewiston		5,000	m	
S. Paris—State gravel road work.				
Massachusetts—				
Needham	$3,000		m	
Orange		2mi	..	
Revere	$3,000		..	
Michigan—				
Hastings		2mi	m	
Holland	$5,000	9,433	m	
Traverse City	$3,500		m	
Minnesota—				
Anoka		½mi	..	
Faribault—Several miles.				
Hopkins		1mi	m	
Mankato		15,000	c	4-—
Sank Center		50,000	m	
Mississippi—				
Gulfport	$1,500	1,000	m	
Starkville		21,020	c	
Missouri—				
Pierce City		2,400ft.	..	
Webster Grove		10mi	..	
Nebraska—				
Chadron		10,000	c	5-—
New Jersey—				
Long Branch	$10,000	30,000	m	
Wenonah	18,000	47,000	c	3-15
New York—				
Albion		10,000	..	
Ellenville	1,200		m	
Herkimer	Some		m	
Johnstown	1,000	2,500	m	
Oneonta	500	5,700	m	
North Carolina—				
Goldsboro		10,000	m	
Wilmington	5,000	6,000	m	
North Dakota—				
Minot	33,000	60,000	c	
Ohio—				
Dayton	14,000	27,600	c	4 and 5
Greenville	200		m	
Rhode Island—				
Tiverton	5,000		..	
South Dakota—				
Mitchell		1½mi	c	
Tennessee—				
Paris		10,000	m	
Texas—				
Greenville		3,500	m	
Longview	$12,000	50,000	m	
Orange	$25,000		m	
Sulphur Sp'ngs—$400,000 in Co. Road Dist.				
Waxahachie		18,000	m	
Vermont—				
Middlebury	$1,500		m	
Washington—				
Grand View		3,000	m	
Puyallup	$ $3,400	5,400	c	3-15
Sunnyside		10,000	c	
Tenino		5,000	m	
Wenatchie	$2,000	6,600	m	
Wyoming—				
Laramie		25,000	m	

MACADAM STREETS AND ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Jacksonville		2mi	c	
Arkansas—				
Mena		50 mi.	co	
California—				
Santa Rosa		10,000	m	
Santa Rosa		4,500	c	
Connecticut—				
Norwalk	$5,000		m	
Willimantic	8,000		..	
Illinois—				
Freeport	22,000	20,000	c	5-—
Rockford		26,000	c	4-—
Salem		100mia		
Indiana—				
Greencastle		30,000	c	
Seymour		3mi	..	
Union City		2,000	c	
Kentucky—				
Pikeville—Pike county will vote May 6 on $500,000 bonds to build 100 miles of macadam and concrete roads.				
Maryland—				
Frederick		6,530	m	
Massachusetts—				
Norwood	$6,000	8,000	..	
Westboro	$4,000		..	
Minnesota—				
Anoka		¾mi	..	
Missouri—				
Clayton		5,000	..	
New York—				
Johnstown	700	1,000	m	
Ohio—				
Greenville	1,000		c	
Oregon—				
Eugene		1,000	c	
Portland	42,229	8,810cy	c	
Pennsylvania—				
Carlisle—Considerable resurfacing.				
Lykens—Some.				
Mt. Joy		1,000	..	
Rhode Island—				
Tiverton	7,000	1mi	..	
South Dakota—				
Lead	3,000	3,000	m	
Vermont—				
Bennington	$5,000		m	
W. Rutland		¾mi	g	

OILED STREETS OR ROADS.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Anniston		35,000	m	
California—				
Richmond		20,000	..	
Santa Ana		2m	..	
Sierra Madre	p	6,300f	m	
Visalia		50,000	m	
Colorado—				
Colorado Sp'ngs		10,600	m	
Connecticut—				
Ansonia	$2,000		c	
Danbury		60,000	c	
Norwalk	$10,000		m	
Willimantic	$3,000		..	
Florida—				
Lynn Haven		20,000	..	
Palm Beach		10mi	..	
Illinois—				
Collinsville—A few streets.				
Delavan		1,600	..	
Galva—Main streets and township roads.				
Freeport	2,400	4mi	c	
Greenville	9,000 — State and county by contract.			
LaGrange		30,000	..	3-1
Mt. Pulaski—All streets in the city.				
Oak Park		59,000	m	
Polo—Most of the city's streets.				
Salem	12,084		c	
Waukegan	6,127	21,000	c	s
Indiana—				
Bluffton—City streets to extent of 3 tanks of oil.				
Crawfordsville—Some by city.				
Crown Point		66,500	c	3-16
Greencastle		30,000	..	
Huntington		10,000f	m	
Jeffersonville		281,600	m	
Lafayette		182,000	c	4 and 5
Laporte		25,000	..	
Noblesville—9 cent levy to oil all streets by city force.				
Kentucky—				
Carlisle	Some		c	
Frankfort—Will use about 60,000 gal. of oil.				
Louisville		1,000,000	c	
Maine—				
Lewiston—Will be done as needed.				
Paris—1½ miles last year.				
Massachusetts—				
Brookline		40mi	..	
Fairhaven	Some		m	
Greenfield—110,000 gal. asphaltic oil.				
Lawrence—Many streets each year.				
Needham	$3,500	150,000	m	
Norwood	$2,100		..	
Orange—About 35,000 gallons.				
Provincetown	$1,000	4,638	m	
Revere	$8,000		c	
Westboro	$2,000		m	
Michigan—				
Traverse City	$1,000		..	
Minnesota—				
Faribault—Several miles.				
Hopkins		3mi	m	
Mankato		60,000	c	4-—
New Ulm—200 blocks.				
Sank Center—Under consideration.				
Willmar		3mi	m	
Missouri—				
Columbia		8,646	c	
Fulton		30,000	m	
Pierce City—One car of oil.				
Sedalia		20,000	m	
Webster Grove		10mi	..	
Windsor		10,000	m	
New Jersey—				
Bloomfield		80,000 gal	c	2-21
Cranford	1,500	90,000	m	
Glen Ridge		10mi	c	
Irvington		200,000	m	
Lambertville		Some	..	
Passaic		240,000	m	
Plainfield—60 mi. with tar.				
Rahway—20,000 gals. of tarvia or asphalt.				
Rutherford	$6,000	50,000	m-c	4-—
Wenonah	$4,000	60,000	c	4-1
Westfield		275,000	m	
New Mexico—				
Albuquerque oil or tar		20,000	c	6-1
Albuquerque—Also some calcium chloride treatment.				
New York—				
Albion		43,500	m	
Buffalo		184,000	m	
Geneva		60,000	m	
Glens Falls		300,000	c	4-15
Gloversville		25,000	c	
Gouverneur	1,000	60,000	..	
Herkimer	Some		m	
Johnstown	500	10,000	m	
Lackawanna		90,000	m	
Middletown	Some		..	
Oneonta	2,977	99,227	c-m	
Watertown	2,750		m	
Ohio—				
Chillicothe		42,000	m	
Dayton—About 34 miles.				
Norwood		160,000	c	5—
Oregon				
Eugene		5,000	m	
Pennsylvania—				
Carlisle		150,000l	..	
Lykens	Some		..	
Morrisville	$1,116		..	
Norristown		21,000	m-c	4—
Renovo		11,000	..	
Rhode Island—				
Woonsocket—100,000 gal. oil applied by city.				

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
South Dakota—				
Aberdeen—Six blocks.				
Tennessee—				
Paris		75,000 gal	..	
Vermont—				
Bennington—About 3 tank cars.				
Middlebury	$750		..	
Proctor		150,000	..	
Virginia—				
Harrisonburg		20,000	..	
Staunton		50,000	m	
Washington—				
Sunnyside		10,000	m	
Wisconsin—				
Antigo		150,000	c	4-—
Baraboo		10,000	m	
Chippewa Falls.		15mi	..	
Janesville		10 mi.	m	
Lake Geneva..		5 or 6mi	..	
Madison		100,000	m	
Manitowoc		20,000	m	
CANADA—				
Ontario—				
Hamilton		1,000,000	..	
Stratford		75,000	m	

WOOD BLOCK.

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Arkansas—				
Hot Springs....		4,000	m	
Illinois—				
Granite City...		22,360	c	
Pontiac		5,000	c	7-1
Indiana—				
Gary		5,000	..	
Logansport		17,000a	..	
South Bend....		140,262a	..	
Iowa—				
Burlington		6,950	c	
Centerville		30,000a	c	
Massachusetts—				
Manchester	$17,400	4,640	..	3-6
Michigan—				
Detroit		40,000	m	
Monroe	$1,200	350	m	
Monroe		450	c	
Minnesota—				
Albert Lea		23,000	c	
St. Cloud		36,000a	c	3-7
St. Paul		90,807	..	
Virginia		25,000a	c	
Missouri—				
Kansas City...		40,000	..	
New Jersey—				
Jersey City....		4,200	c	
New York—				
Buffalo		1,400	c	
Plattsburg		460	c	
Watertown	31,000	9,500	c	3-17
North Dakota—				
Fargo		90,000d	..	
Minot	80,000	25,000	c	3-20
Ohio—				
Dayton	140,000	35,800	c	4 and 5
Norwood		21,000	c	4—
Oregon—				
Astoria		40,000d	c	5 and 6
Eugene—Some.				
South Dakota—				
Huron		30,000d	..	
Wisconsin—				
Chippewa Falls		3,500	c	
Madison		5,900	c	
W. Allis.		15,450	c	
CANADA—				
Ontario—				
Hamilton		2,000	..	
Ottawa		20,000	c	4

MISCELLANEOUS STREET IMPROVEMENTS.

Alabama—

Dothan—City will grade all streets not now to profile and make sand-clay road surfaces.

Hope—Expect to put in 16,000 sq. yds. of paved streets in 1916.

District of Columbia—

Washington—Appropriations are to be made for year beginning July 1.

Florida—

Delano—Much road building by county, none by city.

Live Oak—9,000 sq. yds. Rocmac put in as a demonstration. May pave 13,000 sq. yds. with Rocmac or brick in 1916.

Palm Beach—Extension of city limits will require much new work.

Sanford—Has appropriation of $10,000 for 8,000 sq. yds. of marl pavement to be done by contract, and 100-ft. boulevard along Lake Monroe. City and county have $500,000 bond issue for road work.

Georgia—

Rome—City commissioners do not make appropriations and plans for work until latter part of April.

Idaho—

Boise—Business men's recommendations to spend $100,000 to $200,000 on paving in 1916 will probably be adopted. County will shortly vote on $200,000 bonds for crushed gravel macadam and some oiled road.

Lewiston—About 4 improvement districts will spend some $75,000, and park improvements will cost about $20,000.

Moscow—Will pave about 25,000 sq. yds. Bids will be received about April 15 for all standard form of paving on concrete base and asphalt or something similar will probably be decided upon.

Illinois—

Effingham—County will construct about 15 miles of dirt road including bridges and culverts; appropriation $8,000.

Mattoon—Will probably build $75,000 worth of pavements in 1916.

Salem—Marion county, Ill., contemlpates bond issue to construct 100 mi. macadam and concrete roads.

Savanna—Will probably do some paving and sewer construction after organization of new council, May 4.

Indiana—

Portland—Nothing new in city. Will be some city streets built by county under 3-mile road law.

Massachusetts—

Manchester—$30,000 for general street work.

Michigan—

Jackson—The total appropriation for asphalt, asphalt concrete and brick pavements is $83,189.61.

Marshall—Some talk of paving.

Mississippi—

Summit—11¼ miles interurban railway.

Nebraska—

Hastings—Bids received March 13 on 173,900 sq. yds. of paving, kind to be selected after bids are opened.

Seward—Will pave 20,000 sq. yds. this summer; choice of material to be made after bids are opened in April or May.

New Jersey—

New Brunswick—$60,000 of paving contracted for; more in prospect.

Plainfield—Will construct considerable macadam and permanent pavements.

Ohio—

Elyria—Will pave 17,100 sq. yds. on five streets; kind not stated.

Oklahoma—

Holdenville—About 19,000 sq. yds. of paving in contemplation; kind not yet decided.

Oregon—

Marshfield—Asphaltic rock, 9,000 yards to be let by contract in April or May.

Pennsylvania—

Norristown—Will lay 5,000 yds. of pavement; kind not given, in addition to amounts given in tables above.

Scottdale—Has appropriated $2,250 to lay 10,000 yds. of crushed slag by day labor.

Steelton—Will do about 20,000 yards of paving if bonds are voted in May.

South Carolina—

Charleston—Has appropriated $80,000 for half the cost of street paving in 1916; schedule for year's work not yet prepared.

South Dakota—

Canton—Will pave several blocks; kind not yet decided.

Madison—Resolutions published for 25,000 sq. yds. of paving and about 10,000 more will follow.

Texas—

Lufkin—Will possibly contract for ½ mi. of pavement. County road district No. 5 has voted $200,000 bond issue for good roads.

Quanah—May pave a few blocks of street in 1916.

Washington—

South Bend—$2,000 for 3,000 lin. ft. of plank street to be let by contract.

CANADA—

Alberta—

Calgary—Following estimates are given for street improvements for 1916: Grading, $3,500; boulevarding, $4,650; paving five streets, $22,413.

SIDEWALK IMPROVEMENTS—1916.

SIDEWALKS.

(Concrete unless otherwise noted.)

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Alabama—				
Anniston		5,000	c	s
Jacksonville	$3,000	3,500	c	
Arizona—				
Nogales		8,000	c	
Phoenix		2m	c	
California—				
Los Gatos.		6,328	c	
Marysville		6,000	c	
Orange—Some.				
Orland—1,600 s. y. or more.				
Redondo Beach		27,700	c	5-1
Richmond		5m	..	
Santa Rosa		5,000	c	
Santa Rosa		1,000	m	
Visalia	p	11,000	c	4-—
Colorado—				
Colorado Spgs.		1,000	c	6-—
Durango	p		..	
Ft. Collins	p	8,000f	c	
Ft. Collins	p	1,000fe	c	
Grand Junction	p	3,000	m	
Leadville	2,025	200	c	
Longmont	p	4,000	..	
Longmont	p	2,000e	..	
Connecticut—				
Bristol	p	5,000	c	s
Danbury	Some.			
East Hartford.		2,000	c	
Manchester		15,000	c	
Putnam	Some.			
Delaware—				
Milford	Some.			
Florida—				
Sanford	4,500	5,000	c	
Georgia—				
Athens	5,000		m	
Carrollton	Some.			
Macon	Considerable		c	
Idaho—				
Lewiston		15,500	c	
Moscow	Some.			
Illinois—				
Berwyn	51,000	68,000	c	
Carrollton—$3,000 worth of sidewalks probable.				
Delavan		665	m	
Freeport	4,000	2 mi.	c	
Galva	11,000	2,222	c	
Herrin—$25,000 will be let late in the season.				
Mattoon	Some.			
Moline	28,471	24,500	c	4, 1-15
Mt. Pulaski.	Some		m	
Murphysboro		5,000	c	
Pontiac	Some		..	
Taylorville		5,000 to 10,000		
Indiana—				
Covington		3,000	c	
Crown Point		500	c	
Elwood		5,196	c	3 or 4
Frankfort		4,900	c	
Gary		10,000	c	
Greencastle		44,000	c	
Huntington		1,000	m	
Lafayette		4,000	c	3 to 9
Laporte		556	..	
Marion—Some by property owners.				
Portland		1,000	..	
Union City.		7,000	c	3-—
Wabash		4,000	c	5-1
Washington		21,000	..	
Iowa—				
Burlington—Several miles by property owners.				
Davenport—8 miles by property owners.				
Sioux City.		5,000	c	
Spencer	1,000	10,000	m	

State and City	Appropriation	Sq. Yds.	Cy. or Cont.	Date of Letting
Kansas—				
Arkansas City		1,111	c	
Dodge City—Done by property owners.				
Garden City—Done by property owners.				
Hutchinson—2 or 3 miles by contract.				
Osawatomie		540	..	3-9
Rosedale—Considerable.				
Topeka		10,000	..	
Kentucky—				
Carlisle—Some by property owners.				
Frankfort	Some.			
Louisville		7,053	c	2-23
Louisiana—				
Kentwood—Very little.				
Maine—				
Lewiston		14,000	m	
South Paris	300		..	
Massachusetts—				
Brookline		50,000	..	
Fairhaven		300	c	
Greenfield	5,000	6,000	..	
Needham	2,000	10,000	c	
Norwood	5,000	5,000	..	
Orange—Small amount.				
Provincetown	2,000	8,000	m	
Revere	7,000	5,000	c	3-20
Westboro	5,000		..	
Michigan—				
Alpena		3,800	m	
Ann Arbor	p		..	
Battle Creek		15,000	m	
Detroit		10,000	m	
Detroit		5,000	c	
Eaton Rapids		110	m	
Flint	40,000	45,000	m	
Hastings		2 mi.	m	
Holland		3,000	m	
Jackson	21,000	7 mi.	..	
Ludington		5,000	..	
Manistee	400		..	
Marshall	p		..	
Onaway—30 blocks.				
Sault Ste Marie		5,500	..	
Minnesota—				
Albert Lea		6,000	c	
Anoka		1,760	c	
Bemidji		1,600	c	5-1
Cloquet		½ mi.	c	
Hibbing		2,000	c	
Hopkins		1 mi.	m	
Mankato		6,000	c	4—
Virginia		1,700	..	
Willmar		1 mi.	c	5-1
Mississippi—				
Starkville		1,100	m	
Summit	3,500	3,267	c	4-4
Missouri—				
Clayton		20,000	c	
Columbia		700	c	
Independence		6,667	c	
Kansas City		26 mi.	..	
Sedalia		2 mi.	c	
Webster Grove		75 mi.	..	
Windsor		5,000	..	
Montana—				
Bozeman		1,000	c	4-1
Miles City		2 mi.	c	
Nebraska—				
Chadron		900	c	5—
Holdredge	p		..	
Lincoln	p	25,000	..	
Nebraska City	p		..	
Red Cloud	600	150	c	
New Jersey—				
Bayonne		333	..	
Bayonne		1,000e	..	
Bloomfield		1,600	c	3—
Bordentown	p		..	
Cranford		500	c	
Glen Ridge	Some.			
Irvington		2,200	m	
Lambertville	p	500	..	
Long Branch		3,500	c	4-1
Newark (Milburn Tp.)		450	..	
Newark (S. Orange Tp.)		1,400	..	
Orange		3,000	c	
Passaic		2,200	c	
Plainfield	p		..	
Rutherford	2,300	900	c	4—
Westfield		2,500	c	
New Mexico—				
Albuquerque—Several thousand lin. ft. 6 ft. wide.				
New York—				
Albion		1,000	m	
Buffalo		68,450	c	
Dolgeville		1,000 lin. ft.	..	
Gouverneur	p		..	
Hudson	p	3,000	..	
Jamestown		25 mi.	..	
Johnstown	3,000	3,000	c	6—
Lockport		1,000	c	
Massena		500	..	
Norwich	p		..	
Oneonta	2,065	12,060	c	6—
Plattsburg		2,000	c	
Rensselaer		5,700	..	
Salamanca		9,500	c	
Schenectady	6,000		c	
Utica	Some.			
North Carolina—				
Greensboro		20,000	c	
Plymouth	5,000	5,000	m	
Rockymount		5,000	m	
Wilson		2 mi.	c	
North Dakota—				
Bismark		1,500	..	4—
Fargo		10,000	..	
Minot	4,000	4,000	c	4-3
Ohio—				
Bucyrus	p		..	
Chillicothe		1,800	c	
Cuyahoga Falls—Considerable.				
Dayton		3,450	c	
Greenville	p	6,000	c	
Lakewood		15,000	..	
Lorain		5,500e	c	7—
Marietta	p		..	
Middleport		9,000e	c	
Niles		6,000a	c	
Niles		12,000e	c	
Niles		12,000	c	
Ravenna	Some.			
Steubenville	10,000	8,000	c	5—
Toronto		450	..	
Wapakoneta		300	c	
Oklahoma—				
Bartlesville		4,100	c	4—
Holdenville		2 mi.	..	
Oregon—				
Astoria		14,500	c	4 to 6
Coquille		8,000	c	
The Dalles		3,385	c	
Eugene		12,000	c	
Marshfield		3,600	c	4 or 5
Portland		70,400	c	
Pennsylvania—				
Blossburg	Some.			
Carbondale		42,000e	c	
Carlisle	p	4,000	..	
Farrell		600e	..	
Freeland	p	5,000	..	
Gilberton		1,800	m	
Lansford	3,240	1,800	c	
Lykens	p	1,500	..	
McKees Rocks	p	2,000	..	
Morrisville	208		..	
Norristown	p		..	
N. Braddock		177	c	3 or 4
Oil City		2,000	..	
South Carolina—				
Columbia	12,000		c	
Sumter		12 mi.	c	3-1
South Dakota—				
Aberdeen		1,500	..	
Lead	11,088	4,928	c	
Mitchell		4,000	c	
Sioux Falls		6,500	c	
Yankton		1,100	..	
Tennessee—				
Franklin		5,000	c	s
Newport	5,000		..	
Paris		1,000	c	
Texas—				
Ft. Worth—Considerable, p.				
Greenville	750	2,500	m	
Paris	p		..	
Quanah	p		..	
Sulphur Spgs.	5,000		c	
Waxahachie		2 mi.	c	
Utah—				
Ogden		40,000	c	
Provo		14,000	c	
Vermont—				
Bennington	5,000		c	4-1
Middleburg	1,000		m	
Randolph	1,000		m	
West Rutland—Some.				
Virginia—				
Harrisonburg		5,000	m	
Staunton		4,000	m	
Washington—				
Puyallup	p	2 mi.	..	
Tenino		5,000	..	
West Virginia—				
Moundsville	p	10,000	c	4—
Wisconsin—				
Antigo	p		..	
Ashland		4,000	c	5 or 6
Janesville		1 mi.	..	
Lake Geneva		1,000	m	
Madison		25,000	c	
Marshfield		333	..	
Wyoming—				
Cheyenne	p	1,000	c	
CANADA—				
Ontario—				
Hamilton		10,000	m	
Ottawa	75,000	5 mi.	m	
St. Catharines	8,000		c	
Stratford		10,500	m	

CURB AND GUTTER CONSTRUCTION—1916.

CURB AND GUTTER.

(Concrete combined curb and gutter unless otherwise noted.)

State and City	Appropriation	Lin. Ft.	Cy. or Cont.	Date of Letting
Arkansas—				
Jonesboro	100,000	200,000	c	4-15
Paragould		8,000	..	
Arizona—				
Phoenix		88,000	c	
Phoenix		7,000d	..	
California—				
Antioch		17,500	c	3—
Colusa	1,600	3,200d	..	
Hollister		10,556	..	
Los Gatos		15,500d	c	
Orange	Some.			
Orland—2,000 ft. or more.				
Petaluma		6,000d	c	
Pittsburg	Some.			
Redondo Beach		13,800d	c	5-1
Richmond		5 mi.	..	
Santa Ana	Some, d.			
Santa Rosa		1,000	m	
Santa Rosa		7,000	c	
Turlock		4,800d	c	
Venice		4,000d	..	
Visalia	p	5,000	..	3-13
Colorado—				
Colorado Spgs.		2,000	c	6—
Colorado Spgs.		1,500d	c	6—
Durango	Some, d.			
Ft. Collins	p	6,680	c	
Ft. Collins	p	3,000d	c	
Longmont	b	6,000d	c	6-1
Connecticut—				
Bristol		10,000d	c	s
Danbury	Some, d.			
E. Hartford		2,500d	c	
Manchester		22,500h	..	
New Canaan		3,000d	c	s
Delaware—				
Milford	Some.			
Florida—				
St. Augustine	840	2,800	m	
Sanford	2,000	6,000	c	
Georgia—				
Macon—Considerable grante curb to be put in by city.				
Idaho—				
Blackfoot		5,000d	c	
Lewiston		2,700d	c	
Lewiston		4,000	c	
Moscow	Some.			
Illinois—				
Alton		40,000d	..	
Alton		6,120	..	
Belleville		55,500d	c	
Berwyn	27,000	45,000	c	
Chicago Hgts.		32,000	c	3—
Chicago Hgts.		37,000d	c	s
Danville		15,000h	c	
Delavan		200d	m	
E. Moline	5,107	8,963d	..	
Elgin		44,071	..	
Elgin		8,219d	..	
Freeport	20,000	40,200	c	
Galva		6,000	..	
Granite City		9,950	c	
Lake Forest		20,526d	..	
Lawrenceville		7,000	..	
Marshall		9,822	c	
Mattoon		21,250	c	5—
Mendota		112,000d	c	4—
Moline		2,000d	..	
Moline		31,000	..	
Mt. Pulaski	Some.		m	
Murphysboro		5,000	..	
Murphysboro		3,000d	..	
Naperville		35,500	c	6-1
Oak Park		126,055	c	

State and City	Appropriation	Lin. Ft.	Cy. or Cont.	Date of Letting
Pontiac	4,840	8,800	c	7-1
Pontiac	110	270d	c	5-1
Rockford	.....	44,000	c	4—
Shelbyville	.....	3,000d	..	.....
Indiana—				
Frankfort	.....	8,820d	c	.....
Gary	.....	8,000d	c	.....
Gary	.....	5,000	c	.....
Goshen	.....	4,600d	c	3-6
Goshen	.....	15,000	c	3-6
Greencastle	.....	10,560	c	.....
Greencastle	.....	10,560d	c	.....
Lafayette	.....	10,000	c	3 to 9
Laporte	.....	600d	..	.....
Laporte	.....	4,500	..	.....
Logansport	.....	5,000	c	3-14
Muncie	.....	1,982	..	.....
Portland	.....	6,000	c	3-6
Richmond	.....	5,000	c	.....
Union City	.....	8,000d	c	3—
Union City	.....	4,000	c	3—
Warsaw	.....	8,000	..	.....
Washington	.....	2,100	..	.....
Iowa—				
Anamosa	.....	6,000	..	.....
Atlantic	.....	15,000d	c	6-1
Burlington	.....	4,100d	c	3-1
Cherokee	.....	21,000	c	2-25
Council Bluffs	4,316	7,194	c	.....
Clinton	.....	6,121	..	.....
Creston	.....	45,000	c	.....
Forest City	.....	18,000	..	.....
Ft. Madison	.....	14,265	c	3-1
Greenfield	.....	18,000	..	.....
Manchester	.....	12,000	c	.....
Marion	.....	20,000	..	.....
Mason City	.....	19 mi.d	c	3-13
Pella	.....	164,000	p	.....
Sioux City	.....	10,000d	c	.....
Spencer	8,500	27,000	c	2-23
Washington	.....	1,600	c	.....
Kansas—				
Abilene	5,000	10,000	c	.....
Arkansas City	.....	7,000	c	.....
Council Grove	.....	6,000	..	.....
Dodge City	.....	7,500d	..	.....
Fredonia	.....	25,000	c	.....
Great Bend	.....	15,000	..	.....
Hutchinson—2 or 3 miles by contract.				
Iola	.....	18,000d	c	.....
Lawrence	.....	6,000	..	.....
Lyons	.....	3,000d	..	.....
McPherson	.....	25,000	c	4-1
Osawatomie	1,800	3,500	c	.....
Ottawa	.....	7,000	c	.....
Pittsburg	.....	7,800	c	3-1
Rosedale	.....	15,000	c	.....
Topeka	.....	57,000	..	2-29
Wellington	4,066	23,550d	c	.....
Wellington	15,870	34,560	c	.....
Kentucky—				
Ft. Thomas	.....	20,000	c	3-4
Frankfort	Some.			
Maysville	.....	15,000d	c	3-6
Louisville	.....	24,423h	c	3-3
Louisiana—				
Kentwood—Very little.				
Shreveport	7,500	10,500h	c	.....
Maryland—				
Cambridge—$50,000 loan to curb and gutter streets is asked for from legislature, election to be in July.				
Frederick	.....	1,670	..	.....
Massachusetts—				
Brookline	.....	3,000h	..	.....
Greenfield	.....	1,000h	..	.....
Manchester	1,200	1,000h	c	.....
Michigan—				
Alpena	.....	5,000d	m	.....
Ann Arbor	p	.....	..	.....
Battle Creek	.....	25,000	m	.....
Detroit	.....	50,000d	m	.....
Calumet	.....	1,500	c	.....
Eaton Rapids	.....	4,800	..	.....
Greenville	.....	1,500	c	.....
Hastings	3,442	11,473	m	.....
Holland	8,500	8,500	..	4-1
Jackson	.....	1,512h	..	.....
Jackson	.....	18,871	..	.....
Manistee	2,000	4,000	c	.....
Monroe	.....	1,800	m	.....
Onaway	.....	1,000d	..	.....
Sault Ste Marie	.....	2,000	..	.....
Traverse City	.....	8,000	m	.....
Minnesota—				
Albert Lea	.....	4,000	c	.....
Anoka	.....	4,000	c	.....
Bemidji	.....	3,000d	c	5-1
Cloquet	Some.			
Faribault	.....	10,000d	c	s
Hopkins	.....	5,000d	..	.....
Mankato	.....	5,000	c	.....
St. Paul	26,000d	.....	..	.....
Mississippi—				
Starkville	.....	5,315d	c	.....
Starkville	.....	5,315	c	.....
Missouri—				
Clayton	.....	3,000	..	.....
Columbia	.....	10,776	c	4-15
Fulton	.....	1,400d	c	.....
Independence	.....	20,000d	..	.....
Kansas City	.....	22 mi.d	..	.....
Kansas City	.....	4 mi.	..	.....
Lexington	.....	4,000d	..	.....
Pierce City	.....	400	..	.....
Poplar Bluff	.....	8,000	c	.....
Sedalia	.....	10,560	c	.....
Warrensburg	.....	2,500d	c	.....
Webster Grove	.....	60 mi.d	..	.....
Webster Grove	.....	10 mi.	..	.....
Montana—				
Bozeman	.....	2,000h	c	4-1
Miles City	.....	2 mi.d	..	.....
Nebraska—				
Alliance	.....	5,000	c	5-1
Chadron	.....	2,000d	c	5—
College View	....	2,800d	..	.....
Holdredge	p	.....	..	.....
Lincoln	.....	50,000d	c	.....
Nebraska City—Some contemplated.				
Seward	.....	8,000d	..	4—
New Jersey—				
Bayonne	.....	2,300	..	.....
Bayonne	.....	12,000h	..	.....
Bloomfield	.....	20,000h	..	3 and 4
Bloomfield	.....	40,000	..	4—
Bordentown	p	.....	..	.....
Cranford	.....	1,000	..	.....
Long Branch	.....	12,000d	c	4-1
Irvington	.....	6,800h	m	.....
Lambertville—Very little.				
Long Branch	.....	12,000d	c	4-1
Newark (Milburn Tp.)—10,000 sq. yds. of cobble gutter under county engineer.				
New Brunskick	.....	4,220	..	.....
Passaic	.....	4,000	c	.....
Plainfield	p	.....	..	.....
Rahway	.....	5,000	c	.....
Ridgewood	7,400	10,000	c	.....
Rutherford	1,400	2,000	c	4—
Wenonah	1,200	1,500	co	4-15
Westfield	.....	1,600	..	3-20
New Mexico—				
Albuquerque	.....	36,000	..	.....
New York—				
Albion	.....	150,000h	state	5—
Dolgeville	Some.			
Ellenville	p	1,500	c	5—
Elmira	.....	5,700d	c	.....
Elmira	.....	1,200h	c	.....
Gouverneur	p	.....	..	.....
Herkimer	.....	1,400	c	6—
Herkimer	.....	2,400h	c	6—
Hudson	.....	10,000d	c	.....
Jamestown	.....	20,000	..	.....
Lockport	.....	1,000d	c	.....
Norwich	p	.....	..	.....
Ogdensburg	.....	500d	..	.....
Rensselaer	.....	10,870d	..	.....
Schenectady	.....	10,000	..	.....
Schenectady	.....	35,000h	..	.....
Watertown	.....	5,000	c	.....
North Carolina—				
Asheville	.....	5,000	c	.....
Burlington	.....	7,400	..	.....
Goldsboro	.....	10,000h	m	.....
Rocky Mount	.....	2,000d	m	.....
Rocky Mount	.....	1,000	m	.....
Wilson	.....	10,000	c	.....
North Dakota—				
Bismark	.....	6,000d	..	6—
Bismark	.....	3,000	..	6—
Minot	4,506	9,012d	c	.....
Minot	16,000	32,000	c	10-4
Ohio—				
Chicago Jc	3,655	6,740h	..	.....
Chicago Jc	4,219	7,691	c	.....
Chillicothe	.....	3,200d	c	.....
Chillicothe	.....	3,220	..	.....
Coshocton	.....	1,200d	..	.....
Cuyahoga Falls	.....	15,250h	c	.....
Dayton	.....	27,837d	c	.....
Dayton	.....	16,000	c	.....
Fayette	.....	3,300	c	5-1
Fostoria	2,600	5,218	c	.....
Greenville	.....	6,000d	c	.....
Greenville	p	10,000	c	.....
Lima	.....	5,000d	c	.....
Lima	.....	20,000	c	.....
Lorain	.....	20,000h	c	4-15
Marietta	.....	10,628d	c	.....
Middleport	.....	26,700d	..	.....
Ravenna	.....	7,000d	c	.....
Steubenville	1,200	4,000d	..	.....
Steubenville	4,000	8,000	..	.....
Toronto	.....	8,778	c	5—
Urbana	.....	4,500h	c	.....
Urbana	.....	6,000	c	.....
Oklahoma—				
Bartlesville	.....	14,000	c	4—
Holdenville	.....	5,500	..	.....
Okmulgee	.....	25,000	c	.....
Oregon—				
Astoria	.....	8,000d	c	4 to 6
Coquille	.....	2,800	c	.....
Eugene	.....	15,000	c	.....
Marshfield	.....	7,000d	c	4 or 5
Portland	.....	105,600d	..	.....
Salem	.....	3,824d	..	.....
Pennsylvania—				
Carbondale	.....	35,000h	c	.....
Carlisle	p	5,000d	..	.....
Elwood City	.....	1,600	c	.....
Farrell	.....	1,500	..	.....
Freeland	p	2,400	..	.....
Freeport	.....	5,000	c	6—
Gilberton	.....	2,000	m	.....
Lansford	1,600	2,000	c	.....
Lykens	p	2,000d	..	.....
Meadville	.....	40,000	..	.....
Moorisville	208	.....	..	.....
Norristown	p	.....	..	.....
Northampton	.....	4,564d	c	.....
Northampton	.....	1,500	c	.....
N. Braddock	.....	10,000	..	.....
Oil City	.....	1,800	..	.....
Renovo	.....	1,600d	..	.....
Rhode Island—				
Woonsocket	15,000	15,000h	c	.....
South Carolina—				
Columbia	12,000	.....	c	.....
Sumter	.....	12 mi.	c	3-1
South Dakota—				
Aberdeen	.....	1,000d	..	.....
Lead	Some.			
Madison	.....	10,000	..	.....
Mitchell	.....	14,846	c	.....
Sioux Falls	.....	3,000d	c	.....
Sioux Falls	.....	18,000	c	.....
Yankton	.....	132,000	c	4—
Tennessee—				
Bristol	.....	8,500	..	.....
Dyersburg	Some.			
Dyersburg	.....	10,000	c	.....
Franklin	.....	1,200	c	s
Texas—				
Fort Worth—Considerable, p.				
McKinney	4,500	10,000	c	.....
Paris	.....	10,000	c	8—
Quanah	p	.....	..	.....
Waxahachie	.....	1.6 mi.d	c	.....
Utah—				
Ogden	.....	20,000	c	.....
Virginia—				
Harrisonburg	.....	3,500	m	.....
Staunton	.....	2,000d	m	.....
Staunton	.....	2,000	m	.....
Washington—				
Walla Walla	.....	10,000d	c	3-15
Walla Walla	.....	50,000	c	3-15
West Virginia—				
Charleston	23,850	42,982	c	.....
Moundsville	.....	4,200	c	9-1
Wisconsin—				
Baraboo	.....	5,000	..	.....
Beloit	.....	56,000	c	3—
Chippewa Falls	.....	2½ mi.	..	.....
Delavan	.....	5,000	..	.....
Janesville	.....	2,600	..	.....
La Crosse	.....	3,000	..	.....
Lake Geneva	.....	4,000	..	.....
Madison	.....	40,000	c	.....
Manitowoc	.....	50,000	m	.....
Marshfield	.....	19,729	c	.....
Racine	.....	25,073	c	.....
S. Milwaukee	.....	2,000	c	.....
Waukesha	.....	7,350	c	3-30
Wyoming—				
Cheyenne	.....	8,000	c	.....
Laramie	.....	8,000d	..	.....
CANADA—				
Ontario—				
Hamilton	.....	10,000d	m	.....
Stratford	.....	10,000d	c	.....
Stratford	.....	2,000	c	.....

SEWERS AND SEWAGE DISPOSAL—1916.

SEWERS AND SEWAGE DISPOSAL.

(Vitrified pipe sewers unless otherwise noted.)

State and City	Appropriation	Length Ft.	Size In.	Cy. or Contract
Alabama—				
Anniston		9,500	8	c
Dothan—Extensions in contemplation, also disposal plant, probably not built this year.				
Arizona—				
Nogales—Sewage disposal plant proposed.				
Phoenix		10,000	8, 6	..
Phoenix		15,000j	12, 18	..
Arkansas—				
Hot Springs	8,000	10,000	8, 6	..
California—				
Hermosa Beach		8,300	8, 6	c
Hermosa Beach—Sewage disposal plant contemplated.				
Long Beach—Dozen lateral districts to build shortly.				
Los Gatos		3,658	6	c
Petaluma		1,000	8, 6	c
Petaluma	50,000	2,500	....	c
Redondo Beach	5,000	5,000	8	m
Richmond		75,000	6 to 24	c
Richmond		10,000	3 to 4x6	..
Richmond—Company proposes to put in model sewage disposal plant.				
Santa Rosa		3,000	....	m
Sierra Madre—Sewers and disposal plant for a small district.				
Turlock		1,300	....	c
Venice		8,000i	48	..
Visalia		33,000	6, 8, 10	..
Visalia		14,000i	30	..
Visalia		1,000j	30	..
Visalia—Sewage disposal plant considered.				
Colorado—				
Colorado Spgs.		1,500	....	m
Ft. Collins	p	900	15, 18	..
Longmont		4,000j	12 to 24	m
Connecticut—				
Ansonia	2,500	1,100	....	m
Bristol	p	1,000	8	m
Danbury	10,000		....	..
Greenwich		15,000	....	..
Greenwich—Sewage disposal plant proposed; no appropriation yet.				
Manchester		4,035	10 to 33	m
Norwalk	5,000		10, 12	m
Putnam—Small amount.				
Southington		20,000k	....	..
Willimantic	8,000		8, 10	..
District of Columbia—				
Washington	180,000	80,000	....	cm
Washington	225,000	20,000j	....	cm
Florida—				
Palm Beach	14,000	15,000	18, 24	c
St. Augustine		1,400	18	m
St. Augustine		2,200	15	m
St. Augustine		2,700	12	m
St. Augustine		1,300	10	m
St. Augustine		1,000	8	m
Sanford	3,000	1,800	16, 18	c
Sanford	800	500	12	c
Georgia—				
Cedartown		1,740	8	m
Macon		1,200v	72 to 120	c
Macon		1,200j	72 to 120	c
Macon—Much pipe sewer also.				
Idaho—				
Blackfoot		5,000	10	..
Blackfoot		2,000	8	..
Lewiston		4,000	c	..
Moscow	Some.			
Illinois—				
Alton		40,600	10 to 30	..
Alton		6,155v	33 to 66	..
Belleville		6,000	....	..
Berwyn	20,000	20,000	12	c
Berwyn	13,500	9,000	over 12	c
Berwyn—Has $4,000 appropriation for disposal plant.				
Cowden		3,000	....	..
Danville		10,000	8 to 24	c
E. Moline	3,760	1,700	8	c
Elgin		34,607	6 to 36	c
Elmhurst—$33,000 sewage disposal plant publicly let in fall.				
Fairbury		2,200	10 to 14	..
Galva		2,500j	....	..
Granite City—Outlet sewer to cost $410,000 projected. Assessment roll in court for confirmation. About 5 miles of concrete sewer 4 ft. 6 in. to 9 ft.				
Madison	155,000	35,000	....	c
Marshall		5,924	8 to 15	c
Moline	12,000	1,500	48	c
Murphysboro		26,000	8 to 18	..
Naperville		330	20	c
Naperville		924	18	c
Naperville		2,516	15	c
Naperville		2,912	12	c
Naperville		3,412	10	c
Naperville		5,200	8	c
Naperville		5,000	4	c
Oak Park	27,403	15,647	9 to 24	c
Oak Park		130i	30	c
Rockford		5,000	9 to 18	c
Sandwich—Storm sewer contemplated.				
Savanna—Will do some sewer construction after organization of council, May 4.				
Taylorville		16,000	....	c
Taylorville		6,000v	....	c
W. Frankfort			6 to 15	..
Indiana—				
Anderson		3 mi.	8 to 12	c
Brazil		2,000	8	c
Butler	Some.			
Covington		1,500	12 to 30	c
Covington		210v	30	..
Crawfordsville	311	363	8	c
Crawfordsville		1,600	15	c
Crawfordsville		900	18	c
Crown Point		5,000v	....	..
Fairmount—Sewer system under consideration.				
Frankfort		1,370	10, 12	c
Frankfort		3,210	15-24	c
Frankfort—About 2 miles later in the year.				
Gary		10,000	12	c
Gary		4,000	15	c
Gary		2,550	18	c
Huntington		400	....	c
Lafayette		14,341	8 to 22	c
Lafayette		11,214x	27 to 36	..
Logansport		51,000	....	c
Logansport		4,000v	....	c
Logansport		4,000i	....	c
Marion		1,550	10	c
Marion		2,500	8, 10	c
Muncie		966	10	..
Princeton		20,000	....	..
Princeton—Small septic tank costing $2,000.				
Union City		1,000	12	..
Wabash		5,000	8, 10, 12	c
Warsaw		2,500	10, 12	..
Iowa—				
Burlington		2 mi.	....	..
Burlington		1,000v	....	..
Burlington		1,000j	....	..
Centerville		4 mi.	6 to 12	..
Cherokee		3,000	6, 8	..
Council Bluffs	83,011	92,314	....	c
Davenport—Large amount in next three years.				
Ft. Madison		4,430	12, 15	c
Marshalltown — Some sanitary and storm sewers.				
Mason City—1,000,000-gal. disposal plant. Bond issue, $140,000.				
Pella		9,217	15,000	8 to 10	c
Sioux City		25,000	8	c
Sioux City		3,000j	42	c
Spencer		2,200	2,200	8	m
Kansas—				
Abilene		12,000	3,500j	36	c
Cherryvale—Considerable sanitary sewer work under way.				
Dodge City—One new district to be sewered.				
Garden City—Sewer system in contemplation.				
Holton		500	12 to 24	..
Holton—Reconstruction of disposal plant.				
Hutchinson		2 mi.j	....	..
Iola		6,500	7,035	8	c
Lawrence		6,500	2,700	30	c
Lawrence		1,500	6,000	ditch	c
Lowrence		2,500	550j	....	..
McPherson—Some storm sewers and enlargement, and reconstruction of disposal plant.				
Neodesha			500j	36	c
Neodesha—$30,000 Imhoff tank and sprinkling filter plant will be let this spring.				
Ottawa		4,625	8, 12	c
Ottawa		500j	30	m
Rosedale		20,000	8 to 15	c
Rosedale		3,600j	36	..
Topeka		4,800v	36 to 72	..
Wellington	7,571	11,630	10 to24	c
Wellington		15,800	8 to 15	c
Wellington	10,835	2,920v	30 to 42	c
Kentucky—				
Ft. Thomas		1,400	8	c
Frankfort	Some.			
Louisville	65,000		....	..
Maysville		2,000	12	c
Owensboro—Bids received about April 15 on $225,000 sewer system, about 2 miles, 6 to 8-foot mains and many laterals.				
W. Covington		1,500	12 to 24	c
Louisiana—				
Kentwood—Very little.				
Shreveport		3,000	8, 10	..
Shreveport—27 miles of sewer extensions and a disposal plant in contemplation, and engineer making plans.				
Maine—				
Lewiston		5,300	....	m
Van Buren		800	10	m
Maryland—				
Frederick		810	4 to 12	..
Frederick		1,685x	36, 42	..
Massachusetts—				
Brookline		16,000	8-15	..
Brookline		1,600j	....	..
Farhaven		400	6, 8	..
Lenox—Has voted $20,000 for about 8,780 ft. of 8, 10 and 12-inch sewer and pump and force main to lift sewage to present disposal plant.				
Manchester	500	300	6	c
Norwood	5,200	3,500	8	..
Revere	20,000		....	mc
Winchendon	15,000	2 mi.	....	..
Michigan—				
Alpena	Some.			
Ann Arbor	11,000	13,000	8, 10	c
Ann Arbor	11,500	1,500x	30, 36	c
Ann Arbor	15,000	for storm sewers.		
Ann Arbor	5,600	1,500j	72	c
Battle Creek		24,000	8 to 48	m
Battle Creek		2,000x	30, 36	m
Battle Creek		2,500j	36 to 48	m
Detroit		1½ mi.x	....	..
Calumet		½ mi.	36	..
Eaton Rapids		600	....	..
Flint	125,000	100,000	....	..
Flint	125,000	18,000x	....	..
Hastings		5,000	....	m
Holland—2,500 ft. 5-ft. concrete arch.				
Holland		5,000	8 to 24	m
Jackson	20,000	not decided.		
Ludington	3,000	3,000	....	..
Marshall	Some.			
Menominee	4,500	1,300	24	c
Saugatuck—Will construct main sanitary sewer.				
Sault Ste Marie		4,000	9, 12, 18	..
Minnesota—				
Albert Lea		6,400	6, 8, 10	c
Anoka—Sewage disposal plant and mains.				
Bemidji		2,200	12, 15	..
Faribault		2,500	8	c
Hibbing		3,000	c	..
Hopkins—Sewer system, Imhoff tank and chlorine and filtration.				
Mankato		2,000	8, 12	..
New Ulm—Little sewer work.				
St. Paul—$781,641 contracts let.				
Virginia	Some.			
Mississippi—				
Starkville		1,690	12 to 24	..
Starkville—Sewage disposal plant.				
Summit—Will build sewer system to cost $55,000 to $80,000 and disposal plant to cost $20,000.				
Vicksburg		3,827	15 to 36	..
Missouri—				
Clayton		20,000	8 to 30	c
Clayton		500i	36	c
Independence		2,500	8	..
Kansas City—Will receive bids on 20 miles of sewers, vitrified pipe or concrete up to 30-in., concrete, reinforced concrete pipe, reinforced monolithic concrete or brick over 30-in. diameter, the lowest priced material receiving the contract. Bond issue of $450,000 available for disposal plant but plans not yet drawn.				
Liberty	20,000	17,000	18	m
Poplar Bluff		4 mi.xa	24 to 72	..
Poplar Bluff		4 mi.ja	24 to 72	..
Sedalia		3 mi.	8 to 15	c
Webster Grove—Four septic tanks.				
Montana—				
Bozeman—$200,000 water and sewer bonds to be voted on shortly.				
Livingston		7,082	8 to 12	c
Miles City		1 mi.	6, 8	c
Nebraska—				
Gering	11,500	14,910	8 to 12	..
Lincoln		35,000	8 to 21	c
New Jersey—				
Bayonne		400	....	..
Bloomfield		2,900	15 to 36	c
Bloomfield		2,000	36 to 42	..
Elizabeth	7,000	5,000	....	..
Glen Ridge	Some.			
Irvington		5,000	....	m
Irvington		3,000j	84, 96	m
Jersey City		1,100i	30	..
Newark (S. Orange Tp.)—9,000 ft. of tile sewer.				

State and City	Appro-priation	Length Ft.	Size In.	Cy. or Contract	
Newark (Millburn Tp.)—4,000 ft. of tile sewer and 7,000 ft. of concrete sewer and disposal plant, all under county engineer.					
New Brunswick		5,000	12 to 20		..
Passaic		16,800	8 to 18		..
Plainfield		5 mi.	8 to 18		..
Rahway—Some 8 to 12 in. by contract.					
Rahway	4,000	2,000	8		c
Rahway—Disposal plant.					
Rutherford	7,125	5,280	8		c
Summit—Some sewers and disposal plant.					
Westfield		13,200	8 to 30		c
New Mexico—					
Albuquerque—Storm sewers for all new paving.					
New York—					
Buffalo		11 mi.	10 to 24		c
Buffalo		½ mi.x	36		c
Buffalo		½ mi.i	27 to 48		c
Catskill—State Board of Health requires sewer system.					
Dolgeville		700			..
Elmira		13,800	10, 12		c
Geneva		3,000			m
Gloversville		4,090	12 to 20		..
Gouverneur	1,000				m
Herkimer		1 mi.	8, 10		m
Hornell	5,000	1,480	24		c
Jamestown		5 mi.	8		..
Johnstown	2,000	2,000	8		m
Lackawanna		2,700	8		c
Lockport		1,500	10		..
Norwich—Some.					
Oneonta—Sewage disposal plant.					
Oswego	35,000	5,600	8 to 36		..
Schenectady		1,000	8 to 12		..
Utica		2 mi.			..
Watertown		3,000	10, 12		c
North Carolina—					
Asheville		10,000			..
Goldsboro		5,000	6		m
Greensboro	25,000	50,000			..
Plymouth		10,000			..
Rocky Mount		1,000			m
North Dakota—					
Fargo		15,000			..
Fargo—Some segment block.					
Minot	47,140	17,559	12 to36	5-15	
Minot—$70,000 for two Imhoff tanks and four contact beds.					
Ohio—					
Bucyrus		4,000			c
Chardon	6,000	6,640	6, 8		c
Chicago Jc.	26,732	13,570i			c
Chicago Jc.—Sewage disposal plans on file.					
Chillicothe		2,980	8 to 12		..
Chillicothe		1,370j	36, 40		..
Cuyahoga F'ls.	100,000	52,000	6 to 24		c
Cuyahoga F'ls.		1,500	cast iron 12-in. pipe.		
Dayton		60,875	5 to 24		c
Dayton	250,000	60,000j			4-1
E. Palestine	55,000	14 mi.	6 to 12		c
E. Palestine—Separate sewer system for whole town.					
E. Palestine—$21,000 for Imhoff tanks and electrolytic treatment.					
Fostoria		2,000		c	..
Greenville		15,388	12 to 24		c
Lakewood		20,000	8 to 30		c
Lakewood		2,000x	30 to 54		..
Lakewood		2,000i	42		c
Lakewood		6,000j			c
Lakewood—$200,000 for Imhoff tanks and outlet.					
Lancaster		26,172	6 to 54		c
Lancaster—Alternate bids on sewers over 24-in. for vitrified pipe, reinforced concrete, brick and segment block.					
Lima		6,000	6 to 24		c
Lorain		1,500			c
Lorain	x or i	1,500	60		c
Mansfield		6,000	8		c
Mansfield—Sewage disposal plant.					
Middletown		1,000		4, 5	
Newcomerstown		36,000	8 to 18	5-1	
Niles		7,000			c
Niles		500x			c
Norwood		10,000	15 to 30		c
Norwood		3,000x		36-60	
Painesville		35,000	16,000	8 to 20	c
Ravenna			1,400	24 to 36	c
Urbana			8,000	12 to 18	..
Urbana			1,000j	36, 42	..
Wapakoneta		7,996	7,200	8, 12	c
Wapakoneta			600j	48	..
Oklahoma—					
Bartlesville—$6,000 for disposal plant.					
Enid			80,000	c	..
Holdenville			2,000	8	..
Mangum			300	8	c
Oregon—					
Astoria			10,000	8 to 30	..
The Dalles			1,420	8	c
Eugene			5,000j	8 to 30	..
Marshfield			3,000	6, 8	c
Pendleton—Septic tank possible.					
Portland		120,000	90,000		c
Salem			1,500	8	m
Pennsylvania—					
Altoona—Disyosal plant in contemplation.					
Avoca			1,000		c
Blossburg			1,200	18	..
Carbondale			5,000	6-12	c
Carlisle			1 mi.		..
Elwood City			2,000		c
Farrell			600		..
Freeland		3,600	2,600	12	m
Freeport			2,500	10	c
Gilberton			2,000x	60	m
Lansford		1,466	1,242	8	c
Lykens			½ mi.		..
McKees Rocks.			600	12, 15	m
Meadville		12,000	6,745		m
Meadville		3,000	600x		m
Miners Mills		17,500	17,000	c 3-15	
Montoursville			1,000	12	c
Norristown—Several sanitary sewers to be let later in summer.					
N. Braddock			3,000		..
N. Braddock—Perhaps a 5-ft. storm sewer.					
Northeast		2,000	800	24	m
Oil City			5,000	6 to 10	..
Portage—Sanitary sewers.					
Punxsutawney			1 mi.	8 to 18	c
Ridgway			1,400	8, 12	m
Scottdale		3,430	1,572	12, 24	m
Rhode Island—					
Woonsocket		41,000	1 mi.	8 to 18	c
South Carolina—					
Columbia		150,000		8 to 18	c
South Dakota—					
Aberdeen			2,600	15	..
Mitchell			3,465	8, 10	c
Sioux Falls			15,000	8 to 12	..
Yankton			10,500	10 to 20	..
Tennessee—					
Dyersburg			5,000		m
Fayetteville—Has just completed sewer system. House connections to be laid this year.					
Franklin			600		c
Newport—$5,000 for extensions.					
Texas—					
Childress		30,000	7 mi.	6 to 15	m
Childress—Disposal plant.					
Ft. Worth—Sewage disposal plant.					
Greenville			50,000		m
Greenville—Disposal plant to let June 1, also extensions to sewers.					
Longview—Considering disposal plant.					
Paris			3,000	6	..
Paris—$10,000 for activated sludge plant.					
Quanah—Plans for $25,000 sewers and disposal plant in preparation.					
Sulphur Spgs.		2,000			m
Waxahachie			0.8		m
Waxahachie—Disposal plant by January, 1917.					
Utah—					
Ogden			10,000	8	c
Ogden			4,500j	33 to 51	c
Provo	Some.				
Vermont—					
Middlebury		400			m
Virginia—					
Harrisonburg			1,000		m
Harrisburg—$6,000 for Imhoff tank and sludge beds.					
Staunton			6,000	8, 10	m
Washington—					
South Bend—$1,000 for 2x2 ft. wooden box storm sewer.					
Tenino			2 mi.		..
Tenino—Septic tank, 30 by 90 ft.					
Vancouver		750	850	8	c
Walla Walla		12,000	15,000	6 to 15	..
Wisconsin—					
Antigo	Some.				
Ashland			1,000		6—
Baraboo			2,500		..
Beloit			6,000	6	c
Chippewa Falls			2½ mi.	12 to 24	..
Eau Claire			10,000		m
Janesville—Some vitrified pipe.					
Janesville			2,000j	m	..
La Crosse		42,186	3,516a		c
La Crosse—Sizes are 46x69 and 40x60, to be brick, reinforced concrete or segment block.					
Lake Geneva—Disposal plant.					
Madison			30,000	6 to 24	c
Manitowoc		7,000	6,500	8 to 18	..
Marshfield—Contemplate building two new sewage disposal plants.					
Marshfield			1,261	8 to 24	c
Racine			6,530	8 to 21	c
Racine			1,505i	24, 30	c
S. Milwaukee			3,000	8	c
Waukesha		6,000	6,000		..
W. Allis	Some.				
CANADA—					
Alberta—					
Calgary—$8,500 sewer appurtenances.					
Ontario—					
Hamilton			6,000		..
Ottawa		310,000	2 mi.x		c
St. Catharines.		40,000	2,300		c
St. Catharines.		8,000	3,000		m
St. Catharines—$20,000 system being planned, also small disposal plant.					
Stratford			8,000	9, 12	..
Stratford			5,600j	48	..
Saskatchewan—					
Regina		10,000	4,169	15, 18	..

WATER WORKS IMPROVEMENTS—1916.

WATER WORKS.

(Cast iron mains unless otherwise noted.)

State and City	Appro-priation	Length Ft.	Cy. or Size Contract	In.	
Alabama—					
Dothan—Considerable.					8, 6
Jacksonville—Owners contemplate sand filters.					
Ozark—Will improve pumping station.					
Arizona—					
Phoenix		18,000	..		6,4
Phoenix—Water filtration plant in contemplation; no appropriation yet.					
Arkansas—					
Paragould—Ark. Lt. & Power Co. will change pumping station from steam to electric.					
Tuckerman—Building new water plant.					
Wynne—$20,000 to improve and enlarge water and light plant.					
California—					
Orland—Probably auxiliary steam plant for pumping water.					
Richmond—Water filtration plant under consideration by water commissioners.					
Santa Ana		4,000	..		4
Santa Rosa		2,000	m		
Sierra Madre	$6,000	8,000r	m		4,5,6
Sierra Madre—$3,700 for 26-inch well.					
Sierra Madre—Pumping machinery will be considered.					
Venice—Pumping engine for fire protection.					
Colorado—					
Colorado Sp'ngs		500	m		4,6,8
Durango		Repairsw	m		16,16
Ft. Collins	5,000	2,000	..		4,8,10,12
Longmont			m		4-8.
Connecticut—					
Danbury—Some.					
East Hartford		25,000	..		16-12
Southington		10,000	m		
District of Columbia—					
Washington	Some		..		
Washington—5,000,000-gal. centrifugal pump contract awarded to DeLaval Steam Turbine Co.					
Florida—					
St. Augustine		10,000	..		12-4
Georgia—					
Athens—$40,000 appropriation for sedimentation basin.					
Cedartown —Adding 600-gal. motor-driven centrifugal pump.					
Idaho—					
Moscow—Some.					
Illinois—					
Berwyn		30,000	30,000	c	6
Berwyn—$10,000 in improving pumping station.					
Carrolton—$2,500 of improvements probable.					
Charleston—About $800 appropriated for clear water basin.					
Chicago Hei'ts.		600	..		6

State and City	Appro-priation	Length Ft.	Cy. or S'ze Contract	In.
E. Moline		1,701	..	
Galva—2 wells, 1,525 feet.				
Fairbury—Probably 1 deep well pump in new well to be drilled this summer.				
Kewanee—70,000 will be spent for improvements.				
Madison—$10,000 will be spent for improvements.				
Moline	26,000	10,000	..	6 to 12
Oak Park	36,477	18,981	c	6 to 10
Paris—New concrete dam to cost $94,000.				
Waukegan	16,260	6,180	c	16
W. Frankfort			..	4 to 10
Indiana—				
Crown Point		1,000	w m	
Crown Point—Filtration plant is needed.				
Frankfort		1,000	co	6
Lafayette		1,300	m	6
Marion		2,500	m	6,8
Noblesville—$3,800 a year appropriation for water works pumping station.				
Portland—Water main extensions recommended.				
Iowa—				
Cedar Falls		3,000	..	4,6
Cherokee—Some 6-in. pipe.				
Marshalltown—New 4,000,000-gal. Allis Chalmers pumping engine will be installed about June.				
Pella		15,000	m	6
Sioux City		1,000 tons	..	4 to 16
Sioux City—$12,000 pumping station.				
Spencer	$15,000	20,000	m	
Kansas—				
Iola—May purchase liquid chlorine sterilization plant.				
Lawrence—$60,000 for water mains, $45,000 for filtration plant and enlargement of pumping station in prospect.				
Lyons		1,000	c	4
Neodesha—Probably 2 new boilers.				
Osawatomie		2,300	c	10
Ottawa—$15,000 filtration plant contemplated.				
Louisiana—				
Patterson—$5,500 appropriation for filtration plant.				
White Castle	$3,500		m	
White Castle—New water and light plant will be built.				
Maine—				
Lewiston		1	mi..	
Van Buren		800	m	6
Van Buren		3,000	w	8
Massachusetts—				
Brookline		3	mi..	6 to 12
Brookline—To finish plant started last year.				
Brookline—Pumps for filter plant.				
Lawrence—Probably extensive repairs on filtration plant.				
Lenox—Co. will probably build reservoirs.				
Manchester—$10,000 repairs to pumping plant to be done by city.				
Norwood	$4,900	5,000	..	6
Norwood—$1,500 for open wells.				
Revere	$20,000		m	
Michigan—				
Alpena		3,000	..	6 to 12
Battle Creek		15,000	m	6 to 18
Detroit		5	mi..	
Eaton Rapids		400	..	
Flint		80,000	..	
Greenville—New pump, probably.				
Hastings		7,000	m	
Hastings—150-h.p. boiler.				
Jackson	$65,000	31,356	m	6 to 12
Jackson—500,000-gal. reinforced concrete reservoir.				
Marshall		2,000	m	4,6
Menominee—Exyects to build filter plant.				
Onaway		2,000	..	4,6
Sault Ste Marie		2,000	..	8,10
Minnesota—				
Albert Lea		15,000	c	4,6
Bemidji		1,600	..	4
Cloquet		500	..	6
Cloquet—Plans preparing for $2,000 concrete reservoir.				
Faribault		6,000	m	6,8
Hopkins		1	mi c	6,8
Mankato		600	c	12,16
Mankato—New 1,200-ft. artesian well.				
Mankato—1,500,000-gal. concrete covered reservoir.				
New Ulm—Several blocks of new mains and new deep well pump and apparatus.				
St. Paul—$400,000 new reservoir.				
Thief River Falls—Filtration plant possible.				
Virginia—Some mains, small well and pumping station.				
Willmar		4,200	c	4,6
Mississippi—				
Starkville		1,350	m	6
Missouri—				
Kansas City—5,000 tons water pipe.				
Liberty—A few 4-inch additions.				
Webster Grove—About 50 mi.				
Montana—				
Bozeman—$200,000 water and sewer bonds to be voted on shortly.				
Miles City		1	mi m	4,6
Nebraska—				
Alliance—500,000-gal. reinforced concrete reservoir.				
Chadron		1,200	c	4
Gerring—Will probably extend water mains.				
Lincoln		25,000	m	4 to 12
Seward		2,000	c	4,6
New Jersey—				
Bloomfield		3,500	..	6 to 12
Glen Ridge—Some.				
New Brunswick—New dam, pumping machinery, filter plant and standpipe.				
New Mexico—				
Albuquerque—Election on municipal plant April 4.				
Raton		3,200	c	4
New York—				
Buffalo		10	mi m	
Ellenville		800	m	8
Geneva		2,000	m	
Geneva—Additional filter unit.				
Glens Fals—Some.				
Herkimer		20	mi c	14
Hudson		300	..	4
Johnston	$1,500	2,500	..	
Lockport		1,500	..	6
Norwich	p		..	
Plattsburg		1,000	..	4 to 12
Plattsburg—Liquid chlorine plant.				
Watertown		5,000	m	
Wellsville		5,000	c	6 to 12
Wellsville—Part of $250,000 contract for plant and mains.				
Watertown—$50,000 addition to water plant.				
North Carolina—				
Asheville		3,000	m	6,10
Greensboro		12,000	..	6 8
Lumberton		1,000	..	
Lumberton—$2,792 for four horizontal centrifugal electric-driven pumps.				
Plymouth	$25,000	10,000	..	
Plymouth—$25,000, 15,000 galv. iron.				
Plymouth—Pumping station, tower and tank.				
Wilson—$95,000 for improvements to water plant, including 3,000,000-gal. filter plant.				
North Dakota—				
Fargo		1,000	..	6 to 12
Minot	$18,057	11,119	c	6,8
Minot—Pumping station improvements.				
Ohio—				
Barnesville—Plans for $25,000 filtration plant in preparation.				
Chardon—Drilling well and plans for water works will follow.				
Cuyahoga Falls—Some.				
E. Palestine	$35,000	6,500	m	6 to 16
E. Palestine—Appropriation includes wells and pumps.				
Fostoria	$2,000	1,500	..	4,6
Fostoria—$75,000 for 175,000,000-gal. concrete lined reservoir and 2,500,000-gal. rapid sand filter.				
Greenville		1,600	c	4
Greenville—Probably $35,000 of improvements.				
Lima		10,000	m	4 to 10
Mansfield—Some.				
Middletown—Plans in preparation.				
Norwood		5,000	m	4 to 8
Painesville		5,000	..	4 to 8
Ravenna		1,600	c	
Ravenna—$100,000 for diversion dam and conduits.				
Steubenville—$300,000 new covered reservoir.				
Oklahoma—				
Enid	$5,000		..	6 to 18
Enid—$10,000 bond issue to extend tunnels.				
Oregon—				
Ashland	Steel	6,000	m	8,12
Ashland		2,600	w m	12
Portland	$150,000	15	mi ..	
Pennsylvania—				
Bethlehem		1,000	m	6
Blossburg		1,800	..	4,6
Norristown—Some 4 to 10-ft. pipes.				
Northeast—Will relay some water mains.				
Oil City		5,000	..	6
Punxsutawney—Working toward municipal water plant.				
Renovo—Pumps and 150,000-gal. reservoir.				
Ridgway		2,000	m	6
Rhode Island—				
Woonsocket—Considerable.				
South Carolina—				
Columbia	$200,000		c	6 to 12
Columbia—Extensions probable, including six 1,000,000-gal. filter.				
South Dakota—				
Aberdeen		6 blocks	..	4,6
Mitchell	$850	420	m	8
Sioux Falls		10,000	m	6,8
Yankton		1,700	..	4
Tennessee—				
Bristol—2,000,000-gal. reservoir.				
Dyersburg		2,500	m	6
Newport—$5,000 for extensions.				
Paris—$5,000 for deep well.				
Texas—				
Childress	$10,000	10,000	m	8
Ft. Worth—Enlargement of filter plant and supply conduit.				
Lufkin		2	mi ..	
Lufkin—$10,000 pumping unit to be installed.				
Paris		3,000	..	4
Quanah		2,260	c	6
Sulphur Sp'gs.	$6,000		m	8
Waxahachie		2.6	mi m	
Utah—				
Provo		2,000	..	4
Vermont—				
Randolph		2,000	..	6 to 10
Virginia—				
Harrisonburg		5,000	m	
Staunton		5,000	m	4,6
Washington—				
Sunnyside		1,000	w ..	
Tenino		7,000	w co	6 to 10
Wisconsin—				
Antigo		2,500	c	6
Eau Claire		4,600	m	4 to 10
Janesville—Some 4 and 6-in. extensions.				
La Crosse		1,200	..	6
Madison		25,000	m	6 to 20
Madison—$200,000 to rebuild pumping station.				
Manitowoc		3,000	m	6
Manitowoc—Light and water plant, 3,000,000-gal. pump.				
Marshfield		3,254	c	4,6
Menasha		½	mi ..	
Menasha—Filtration plant to be built this summer, costing about $115,000.				
S. Milwaukee		4,000	c	6
Waukesha		8,000	m	
W. Allis—Some 6-in. pipe.				
CANADA—				
Alberta—				
Calgary—$124,700 enlargement of reservoir and extensions of mains and connections.				
Ontario—				
Hamilton		7,000	..	6
Ottawa—$50,000 short main extensions, 4 to 12.				

ORNAMENTAL STREET LIGHTING—1916.

STREET LIGHTING.

Alabama—

Dothan—Contemplate extension of White Way by city.

Ozark—Eight 5-lamp ornamental standards, 110 and 60 watt lamps by city.

Arizona—

Phoenix—Three hundred standards with 110-volt lamp by city.

Arkansas—

Paragould—Seventy-seven 5-lamp standards, 200 c.p. to each standard by company.

Tuckerman—Building electric light plant.

Wynne—Will spend $20,000 improving and enlarging municipal water and light plant.

California—

Colusa—Twenty standards with 40 lamps.

Orange—Forty-four standards with 44 400-c.p. lamps.

Richmond—Two hundred standards with 200 110-volt lamps by company.

Santa Ana—Seventy standards with 70 400-c.p. lamps by city.

Colorado—

Ft. Collins—Twenty-six standards with 3 and 5 110-volt, 7-ampere lamps. May change system and instal 800 series in-

candescent 110-volt, 7-ampere lamps. Company pays for construction city for operation.

Connecticut—
Wallingford—$3,000 appropriated for proposed White Way on Main st. A. L. Pierce, supt. electric plant.
Willimantic—Has 133 standards with 133 50-watt lamps at $20.50 a year and 100 standards with 100 320-watt lamps at $80 a year.

Florida—
Palm Beach—Five 5-lamp ornamental standards with 110-volt lamps.
Sanford—Fifty standards with 150 500-v. d.c. lamps.

Georgia—
Toccoa—Fifty single lamp standards with 250-c.p. lamps to be installed by city.

Illinois—
Belleville — Sixty-five ornamental light standards with 65 400-c.p. lamps will be put in by company.
Berwyn—Twenty-four ornamental light standards with 24 220-volt lamps will be put in by city.
Chicago Heights—Will soon make contract with Public Service Co. or Chicago Heights Gas Co. or possibiy city will put in ornamental light standards.
Delavan—Three 5-light standards with 32-w. lamps will be put in by city.
Galva—Forty-three 5-lamp standards of 40-watts each to be put in by city.
Greenville—Twelve 5-lamp standards to be put in by city.
Oak Park—Have contracted for many new street lamps and substitution of 250-c.p. nitrogen mazda lamps for the 400 or more arc lamps now in use.
Whitehall—Will vote this spring on bonds to build municipal electric light plant and distribution lines to cost $28,000.

Indiana—
Alexandria—Has been considering ornamental lighting, but nothing has been done yet.
Anderson—Municipal light plant will spend $150,000 for boilers, coal conveyor, etc.
Crown Point—Ten ornamental light standards with 3 100-volt lamps each to be put in by city.
Huntington—Now installing 391 single light standards 24.6 and 14.4-watt lamps; city operates.
Noblesville—Company to put in 34 600-c.p. lights on single-light standards.
Richmond—Has let contract for new $30,000 unit of municipal lighting plant.
Seymour—Merchants contemplate ornamental lighting led by Nathan Kauffman.
Union City—City will put in 60 single-lamp ornamental standards.
Wabash—Ornamental lighting contemplated.
Warsaw—Ornamental light under consideration.

Iowa—
Manchester—City will put in 60 5-light and 15 single light standards, 110-volt lamps.

Kansas—
Holton—Expect to build 23 miles of transmission lines. Will purchase 50-k.w. transformer, lightning arresters, panel for switchboard and possibly a new engine and generator.
Hutchinson—One hundred 4-lamp standards; city pays for installation.
Lyons—Sixteen 3-light standards.
Ottawa—Contract awarded for new White Way, $7,130 appropriated for installation on 6 blocks, 80 single lamp, iron standards, 400-c.p. lamps. Contemplate new steam turbine in municipal light and water plant.
Wellington—City will install 30 ornamental standards.

Louisiana—
White Castle—Will build new water and light plant.

Maine—
Van Buren—Have just installed 3 mi. of lighting system.

Massachusetts—
Lawrence—White Way under consideration on one principal street.
Norwood—$16,000 appropriation for underground electric wire conduit.

Michigan—
Detroit—Ninety-six 1,000-v. lamps on 96 standards will be put in.
Eaton Rapids—Twenty single lamp standards will be put in by city.
Sault Ste Marie—Sixty-six 400-c.p. single lamp standards will be put in by city.

Minnesota—
Sauk Center—White Way under consideration.

Missouri—
Pierce City—Twenty-seven two lamp standards will be put in by city.
Warrensburg—Ornamental lighting being agitated.

Montana—
Deer Lodge—Probably 100 6.6 amp. single lamp standards to be put in by city.

Nebraska—
Gering—Fifty new lamps.
Havelock—Fifteen or 16 new ornamental standards.

New Jersey—
Ridgwood—Seventy-five 60 c.p. single lamp standards to be put in by the city.

New Mexico—
Raton—Municipal light plant voted on in April.

New York—
Ellenville—Fifty-eight 400 c.p. standards by company.
Herkimer—About 30 500-watt single lamp standards to be put in by city.
Schenectady—One hundred single lamp standards to be installed by city.
Utica—May be some by property owners.
Watertown—Fifty 3 to 5-light standards, 60-v. lamps will be installed by lighting company.

North Carolina—
Gastonia—Sixty-three single light standards,600 -c.p. lamps to be installed by city.
Lamberton—$9,947 to be spent on changing electric system to alternating current, company to furnish current.

North Dakota—
Fargo—One hundred and two single light standards, 80 c.p. lamps to be installed by city.
Minot—One hundred 5-light standards, 40 and 60-watt lamps to be put in by city.

Ohio—
Bellefontaine—One hundred and one single-light standards, 600-c.p. lamps, to be put in by city.
Chicago Junction—Municipal light plant may install ornamental lights.
Dayton—Four hundred and one 5-light standards by company.
Norwood—One hundred and fifty 110-v. lamp standards by city.

Oklahoma—
Bartlesville—Possibly in proposed new park.
Mangum—Possibly a lighting plant.
Okmulgee—Forty-eight single-light standards, 300-c.p. lamps, to be put in by city.

Oregon—
Eugene—One hundred and fifty 5-light standards, 110-volt lamps, by city.

Pennsylvania—
Blossburg—Ten 3-light standards, 110-volt lamps, by city.
Carbondale—Under consideration.
Lykens—Forty-five suspended lamps, 250-c.p. 110-volt, nitrogen.

South Dakota—
Madison—$15,000 building for city lighting plant.

Tennessee—
Dyersburg—Electric light extensions.
Newport—$5,000 bond issue for electric street lighting and wiring.
Paris—Considering 20 5-light standards.

Texas—
Paris—Seventy single-light standards, 100-watt lamps, by city, probable.

Wisconsin—
Chippewa Falls—One hundred and eighteen single-light standards, 400-c.p. lamps, by city.
Janesville—One hundred and thirty single-light standards, by city.
La Crosse—Ten or 12 5-light standards, 80 to 100-ampere lamps, by city.
Madison—One hundred and forty-five single-light standards, 1,000-c.p. lamps, by city.
Manitowoc—$70,000 water and light plant.
Menasha—Sixty-five single light standards, by city.

CANADA—

Alberta—
Calgary—$46,000 for switch board and equipment, underground cable, storage batteries, lightning arresters and appurtenances.

BRIDGES—1916.

BRIDGES.

Alabama—
Dothan—Will build some small bridges.

Arizona—
Nogales—Two concrete bridges.

Arkansas—
Arkadelphia—One 40-ft. bridge considered.

California—
Hermosa Beach—Viaduct contemplated.
Placerville—One concrete bridge, $700 appropriation.
Redondo Beach—One wooden bridge 84 ft. long, 20-ft. roadway will be let by contract May 1.
Sierra Madre—One wooden bridge, appropriation $495.
Venice—One concrete bridge, $8,000 appropriation.

Colorado—
Colorado Springs—Two wooden bridges, 63-ft. span and 3 conduits.

Connecticut—
Bristol—$10,000 appropriation for bridges.
Southington—One bridge, $1,000, to be built by town and state, and one at $2,500 to be built by county and state.

District of Columbia—
Washington—$110,000 appropriation for grade-elimination viaduct.

Florida—
Lynn Haven—$25,000 bonds to be sold to build 2 bridges of about 100-ft. span each.
Sanford—100-ft. steel bridge and 900 ft. of trestle approaches.

Georgia—
Cedartown—$2,000 appropriation for 50-ft. concrete bridge now under construction.

Idaho—
Moscow—$3,000 concrete bridge in contemplation.

Illinois—
Berwyn—Has $7,000 appropriation for bridges.
Chicago Heights—One concrete arch.
Collinsville—Cantine Creek bridge.
Marion—$5,000 for bridges.
Rockford—$82,000 concrete bridge over Rock River at Morgan St., let to J. J. O'Heron & Co., of Chicago, Ill.
Salem—Nine reinforced concrete bridges on county roads let at $10,550.
Waukegan—Bridge on Sheridan road.

Indiana—
Bluffton—Over $20,000 worth let to C. T. Kain March 8, all steel and concrete.
Frankfort—One small concrete bridge, appropriation $1,000.
Richmond—Two bridges by county commissioners.

Iowa—
Anamosa—County will build about 25 bridges, steel on concrete abutments, with concrete floors, up to 70-ft. span.
Burlington—Bridge across Mississippi river let to Wisconsin Bridge Co.
Cedar Falls—Bridge across Cedar River, 5-span concrete arch or steel girder.

Kansas—
Iola—One bridge by city and 2 by Mo. Pac. Ry.
Lyons—Several reinforced concrete culverts, four over 6-ft. span.
Topeka—Three reinforced concrete bridges; appropriation, $25,000.

Louisiana—
Kentwood—Possibly some.

Maine—
Lewiston—One hundred twenty-five ft. steel bridge.

Maryland—
Frederick—One small concrete foot bridge.

Massachusetts—
Brookline—Two steel and concrete highway bridges.
Lawrence—Two bridges to be built by city or local corporation.
Revere—Small concrete bridge.

Michigan—
Ann Arbor—Plans for $10,000 to $15,000 bridge.
Eaton Rapids—One small bridge.
Holland—Three very small bridges.
Monroe—Two bridges, appropriation $60,000.

Minnesota—
Bemidji—$17,000 steel and concrete bridge.
Cloquet—$977 repairs to bridge.
Faribault—$4,000 for three small bridges.
Mankato—Bridge with five 90-ft. arches, 32-ft. roadway with street cars, two 6-ft. walks.

Nebraska—
Alliance—Two bridges 40-ft. span, 16-ft. roadway.
Lincoln—$3,000 appropriation.
Seward—One concrete bridge, $1,000.

New Jersey—
Irvington—$13,000 appropriation.
Lambertville—Hunterdon county plans new bridge.
Newark—Three new concrete bridges in the township.
Wenonah—$14,000 appropriation and $27,000 bonds for county bridges.

New Mexico—
Albuquerque—Several small wooden bridges rebuilt.

New York—
Buffalo—Three bridges, costing $184,700.
Elmira—$4,000 appropriation for small reinforced concrete bridge and retaining walls.
Gloversville—Reinforced concrete 30-ft. span, 50-ft. width.
Lackawanna—$4,000 for one bridge.
Niagara Falls—Flat concrete arch, 25-ft. span, 50-ft. wide, $5,000; grade crossing elimination, $454,000.
Oneonta—Two slab-floor bridges, $2,000.
Watertown—One $25,000 concrete bridge will be let about April 1.

Ohio—
Cuyahoga Falls—Will probably widen Portage street bridge.
Dayton—Three concrete bridges, estimated at $500,000.
East Palestine—$1,000 for 18-ft. concrete culvert.
Norwood—Three concrete bridges proposed.

Oklahoma—
Enid—$30,000 bond issue for concrete bridges proposed.
Okmulgee—$25,000 bonds for bridges probable.

Oregon—
Astoria—About $6,500 ft. of street to be improved by constructing viaduct.
Portland—$530,000 appropriation for nine viaducts.

Pennsylvania—
Peckville—Lackawanna Co. Commrs. will build concrete bridge over Lackawanna river.
Blossburg—Two bridges.
Carbondale—Three small bridges.
Meadville—$5,000 for three concrete slab bridges.
Norristown—$25,000 bridge, $5,000 park bridge.
Portage—Twenty-five-ft. span, 50-ft. width reinforced concrete.
Rankin—Probably one.
Scottdale—$2,600 for two small concrete bridges.

Rhode Island—
Woonsocket—$10,400 for two small bridges.

South Dakota—
Lead—One bridge.
Yankton—$5,000 for 50-ft. concrete arch.

Tennessee—
Bristol—One bridge.

Vermont—
Randolph—One or two.

Virginia—
Harrisonburg—Probably two.
Staunton—Two bridges.

Washington—
Sunnyside—$500 for two bridges.
Walla Walla—$6,000 for two reinforced concrete girders.

Wisconsin—
Beloit—Possible three 70-ft. arch concrete Central Bridge.
Janesville—Redecking or new bridge over Rock river.
Madison—$8,500 for concrete arch.
West Allis—$2,000 for one concrete bridge.

CANADA—

Alberta—
Calgary—Three concrete bridges, $58,000, $375,000 and $75,000.

GARBAGE DISPOSAL, PUBLIC BUILDINGS AND MACHINERY—1916.

GARBAGE DISPOSAL PLANTS.

Alabama—
Anniston—Expects to build $5,000 crematory.

California—
Venice—Garbage incinerator proposed.

Illinois—
Moline—Garbage incinerator contemplated.

Massachusetts—
Brookline—May build incinerating plant.

Michigan—
Traverse City—Incinerator to be voted on.

Minnesota—
Hopkins—Probably instal incinerator.

New Jersey—
Glen Ridge—Incinerator costing $15,000.

New York—
Buffalo—Twenty-ton destructor.

Pennsylvania—
Blossburg—New site and plans under consideration.
Rankin—Will purchase motor garbage truck.
Titusville—Plans will be completed this year.

Tennessee—
Franklin—Considering incinerator.

Wisconsin—
West Allis—Disposal plant, $4,600.

PUBLIC BUILDINGS AND OTHER STRUCTURES.

Alabama—
Dothan—Remodeling of fire and police station.

Arkansas—
Hope—Four-story bank building.

California—
Long Beach—New bulkhead on west beach, plans under way; also for flood protection. Petition for $500,000 horse-shoe pier will be voted on.
Venice—Ocean front protection. Concrete tunnel 6 ft. by 10 ft. 1,000 ft. long.
Durango—$175,000 high school building, bonds sold $150,000 Federal building, appropriation made; $50,000 building for Modern Woodmen contemplated.

Connecticut—
Wallingford—$125,000 high school.

Iowa—
Atlantic City—City hall, $25,000; two hotels, $30,000 each, and other smaller buildings.

Kansas—
Columbus—$55,000 county high school.
Neodesha—$20,000 hospital, $20,000 office bldg.

Kentucky—
Owensboro—$40,000 city hall.

Massachusetts—
Manchester—$6,000 for fire prevention apparatus in three buildings.

Minnesota—
Virginia—City hall to be built.

Mississippi—
Gulfport—$75,000 county court house, $500,000for grounds and buildings of Mississippi Centennial.

Nebraska—
Gering—Large high school building, large sugar factory, much building in all lines.

New York—
Plattsburg—$200,000 city hall will be started this spring.

North Carolina—
Burlington—$30,000 for city hall, $38,000 for school, $65,000 for postoffice, $30,000 for office building.

South Dakota—
Madison—$15,000 for city lighting plant building.

Tennessee—
Bristol—$60,000 high school building.

Wisconsin—
Lake Geneva—$28,000 city hall.

MACHINERY AND SUPPLIES TO BE PURCHASED.

Arizona—
Nogales—Concrete mixer.

Arkansas—
Helena—May purchase sewage pumping machinery.

California—
Petaluma—Steam 5-ton tandem roller.
Visalia—Considering purchase of a tractor or roller and a sweeper. Kinds not yet decided.

Colorado—
Ft. Collins—Will probably need a large concrete mixer.
Longmont—Probably some street cleaning machinery.

Connecticut—
Putnam—Street sweeper or flusher.

Delaware—
Milford—May purchase a street sweeper.

Florida—
Sanford—Road roller, wheeled scrapers, dump wagons for use on a combined city and county road job with a $500,000 bond issue.

Illinois—
Belleville—Possibly a road roller.
Chicago Heights—Steam roller, large grader, scarifier and probably a sweeper.
Mt. Pulaski—Tank wagon for oiling streets, probably buying one now owned by business men's committee.

Indiana—
Bluffton—Expect to purchase 1,200-yd. motor-driven asphalt plant and steam heater for asphalt.
Crawfordsville—Expect to purchase a combination heater and pressure distributer for oiling streets.
Gary—A 10-ton roller and a 1½-ton auto delivery truck.
Marion—Just purchased 1,600-gal. Studebaker sprinkler and 1-horse dump cart.
West Lafayette—Probably grader or drag.

Iowa—
Davenport—Sprinkler wagon, road grader, two or three plows, shovels, etc.
Pella—Need gasoline 8-ton road roller.

Kansas—
Holton—See under "Lighting."
Lawrence—Street sweeper.
Lyons—Road grader.

Kentucky—
Pikeville—Brooms for sweepers.

Louisiana—
White Castle—For new water and light plant.

Massachusetts—
Brookline—Steam road roller and scarifier. Pumps for filter plant.
Revere—Steam roller; paving mixer; small compressed air plant; water-main tapping machine.

Michigan—
Dertoit—Probably a trench excavator and several trucks.
Flint—Revolving type steam shovel; sewer excavating machine; crane for unloading gravel from cars.
Hastings—Possibly a 150-h.p. high pressure boiler for water works.
Holland—Possibly a mechanical tamper.
Ludington—Possibly an asphalt mixer and a tandem roller.

Minnesota—
Albert Lea—Lifting apparatus for sewage.
Hibbing—New power plant talked of.
Mankato—Street cleaning machine.
New Ulm—Deep-well working head, 7¾-in. barrel pump, 80-lb. pressure, 60-h.p. motor; estimated cost $5,000.
Willmar—Probably new generator for electric light plant.

Missouri—
Sedalia—Probably street graders.

Nebraska—
College View—Possibly new pump, street sweeper, street sprinkler.
Wahoo—175 Kva. generator, direct-connected to 225-h.p. Corliss engine.

New Jersey—
New Brunswick—Two 5,000,000-gal. turbo-centrifugal pumps.
Passaic—Street flushing machine.
Rahway—Vacuum street sweeper, scarifier.

New Mexico—
Albuquerque—Probably new street equipment and sewage pump.
Raton—Eight or twelve-h.p. gas engine and rock crusher.

New York—
Jamestown—Possibly steam roller.
Lockport—Stone crushing machinery.
Niagara Falls—Three-ton steam roller.
Plattsburg—Liquid chlorine plant.
Utica—Sewer cleaning machine.

North Carolina—
Lumberton—Four horizontal centrifugal pumps, electric drive.
Plymouth—Possibly road roller.
Rockymount—Concrete mixer.
Wilson—Pumps; gas plant.

Ohio—
East Palestine—Pumping engine, pumps and boilers.
Greenville—Street sweeper.
Newark—Probably 300-kw. turbo-generator and boilers.

Pennsylvania—
Bethlehem—Gasoline road roller, motor street flusher.
Franklin—Probably a truck.
Meadville—Small concrete mixer and small tar kettle.
Rankin—Motor garbage truck.
Scottdale—Roller; street flusher.

Waynesboro—Portable crusher; heating kettle.
Wilkes-Barre—Street cleaning apparatus.

South Carolina—
Bennettsville—Seventy-five-ft. 40-in. steel smoke stack; possibly electric driven pumps.

South Dakota—
Aberdeen—Booster pump and 125-h.p. motor for sewage pumping station.
Mitchell—Street flusher; street sprinkler.

Tennessee—
Dyersburg—Street flushing machine, motor truck.

Texas—
Childress—Probably trenching machine.

Vermont—
Middlebury—Dust-laying apparatus; 2-horse road machine.

West Virginia—
Moundsville—Possibly dump wagon and garbage cart.

Wisconsin—
Baraboo—Stone crusher.
Eau Claire—Meter tester, vertical turbine, motor car for water department.
Janesville—Road roller, road oil distributor with pressure devices, motor car in water department.
Manitowoc—Three 300-h.p. boilers, 750-k.w. turbo unit with all auxiliaries.

COMPARISON WITH CONDITIONS IN 1915.

COMPARISON WITH CONDITIONS IN 1915.

Alabama—
Dothan—More in 1916.
Jacksonville—Work started last year will take all the funds.
Mobile—Business conditions brighter. Improvements made on petition and cannot be predicted now.
Ozark—Much better prospects for 1916.

Arizona—
Nogales—About 50 per cent. more of various improvements than in 1915.
Phoenix—More paving and work of all kinds.

Arkansas—
Helena—General prospects 1916 poor, 1915 was good.
Hot Springs—Will do more in 1916 than in 1915.
Jonesboro—Prospects far better in state in lines of construction work. City will do far more than in 1915.
Pine Bluff—Plans not made until after April 1.

California—
Anaheim—More paving and not so much sewer work.
Colusa—Not so promising. Town will do as little work as possible.
Hollister—About the same.
Los Gatos—Less in 1915. City heavily bonded.
Marysville—New council comes in April 1 and will plan work.
Oakdale—Will do more in 1916, owing to the country being developed.
Oakland—Probably somewhat less than in 1915.
Orange—Too early to estimate.
Petaluma—Street and highway work good in 1916.
Pittsburg—Not much better than 1915 in street and sewer work. Will do considerable of both, not yet lined out.
Placerville—Will do considerable street paving if bond election carries in April.
Redondo Beach—Outlook for 1916 good for considerable work, especially in street paving; no street work done in 1915.
Richmond—Not as much as in 1915, which was a big year, but better class of pavements will be laid.
Santa Ana—Possibly more paving than in 1915. Prospects better.
Santa Rosa—Will do some work, and considerable if court decision on it is favorable.
Turlock—Will do more work than in 1915.
Vallejo—More work than last year, especially in paving.
Visalia—Prospects for paving better than for many years.

Colorado—
Colorado Springs—Construction work will not be as heavy as in 1915.
Durango—Prospects for 1916 are much brighter.
Ft. Collins—More paving than any previous year.
Grand Junction—City work about the same. Generally better year is expected.
Leadville—Is struggling under a judgment debt and will do little improvement for seven years.
Longmont—Will do about 50 per cent. more concrete paving.

Connecticut—
Ansonia—Very little construction work this year.
Bristol—About the same.
Danbury—Times will be better.
Greenwich—Each year about the same.
Manchester—Prospects better and will do more work.
New Canaan—Will do road work chiefly.
Norwalk—Expect to do more than twice as much work as in 1915.
Putnam—Very little work contemplated on account of high cost of labor and material.
Southington—New work will be light on account of high prices and scarcity of labor.
Wallingford—Not much paving, sewers or water mains, as prices of materials and labor are too high.
Wethersfield—No new work, merely resurfacing old macadam.
Willimantic—About same as in 1915.

Delaware—
Milford—Probably not as much city improvement as in 1915.

District of Columbia—
Washington—About the same prospects for work as in 1915.

Florida—
Live Oak—Nearly stops work this year to recover from complete sewer system, new pumping station and vitrified brick paving recently constructed.
Lynn Haven—Will probably not do as much as last year.
Palm Beach—Will probably build more streets, sidewalks and sewers than last year. About half of a $100,000 bond issue remains to spend on streets, sewers and sea wall. Extension of city limits will require much city improvement work soon.

Georgia—
Carrollton—General conditions improving.
Macon—Will do more curb, sidewalk and storm sewer work in 1916.
Moultrie—Stopped improvements to recover from 45,000 sq. yds. asphalt concrete and 3,000 sq. yds. concrete sidewalks.
Toccoa—General condition improving.

Idaho—
Blackfoot—Will do more work in 1916, principally paving.
Boise—Will probably do no work except the paving program outlined under Miscellaneous Street Improvements.
Moscow—More paving, storm sewers and cement sidewalks.

Illinois—
Alton—Will do much more work in 1916, especially in paving and sewers. $100,000 for sewers and $200,000 for paving, all to be done by contract and paid for by local assessment bonds.
Belleville—Will do more paving work.
Berwyn—Will do more work in 1916 in pavements, vitrified pipe sewers, water mains and electric light system.
Charleston—Did no work last year and will do little or no work this year.
Chicago Heights—Prospects are much brighter, especially in pavements.
Collinsville—No work to be done except oiling of streets.
Danville—About the same as last year.
East Moline—More paving and storm and sanitary sewers than in 1915.
Freeport—Expect to do a great deal more paving.
Galva—More paving and sidewalks than in 1915.
Granite City—Considerable paving and sewer work for 1916, including $410,000 outlet sewer.
Herrin—Very little will be done this year.
Kewanee—No paving or sewer improvements contemplated this year.
LaGrange—About the same as 1915.
Lake Forest—Hope to do more paving this year.
Lawrenceville—About same as last year.
Madison—Will build nothing but the sewer system, $155,000.
Marion—Prospects good.
Mattoon—Business looks good for 1916.
Momence—No prospects until after spring election.
Mt. Pulaski—Expect better business in 1916.
Murphysboro—Construction prospects are brighter for 1916. Will probably do more sewer work.
Oak Park—Have planned a third more paving than last year and largely increased sewer and water main construction.
Polo—Is well sewered and needs very few more sidewalks.
Taylorville—Will probably do more than in 1915. Sewer system costing $55,000 probably most of work to be done.
Waukegan—Will have more work than last year in water and sewer extensions, and water works improvements.
Wheaton—Prospects look good for land reclamation by drainage. No city work in sight at date of report.

Indiana—
Brazil—About the same as 1915.
Covington—Not much work in city in 1916, but fully as much in county.
Crawfordsville—Will build less sidewalks, curb and gutter, but will build more paving and sewers and oil more streets.
Crown Point—1916 will be almost normal; probably less than 1915.
Elwood—About same as 1915.
Frankfort—Will do about twice as much work as last year, principally in sewers.
Gary—More than last year, chiefly in sewers and sidewalks for real estate developments.
Greencastle—Prospects good.
Huntington—Will be much less work than in 1915.
Lafayette—Prospects bright for big year in 1916, especially in sewers. No paving yet in prospect.
Laporte—Will have about five times as much work in 1916 as in 1915.
Logansport—Will be more sewer construction than last year. Other prospects not so good, as tax rate on streets under three-mile road law has been worked to its limit.
Princeton—Prospects for 1916 very good, especially in sanitary sewers.
Richmond—Will do a good amount, but not as much as in 1915, which was a banner year.
Union City—More construction of brick pavements in 1916.
Wabash—A little more work than in 1915 in streets and sewers.
Warsaw—More paving proposed for 1916.
Washington—Will do much more than for several years. More than is reported under sidewalks and curb and gutters.

Iowa—
Atlantic—Prospects are better for 1916. Are ahead of needs of city on sewers and water mains and spent $10,000 last year on light and water plant.
Burlington—Will probably not do as much work as last year. New council April 1.
Cedar Falls—About same as 1915.
Cedar Rapids—No work.
Centerville—Prospects good for much more sewer work and about same amount of paving as in 1915.
Cherokee—More paving, less sewers and water mains than in 1915.
Council Bluffs—Prospects not so good for 1916. "Town went dry."
Creston—More sewers and paving in 1916.
Ft. Madison—More paving.
Keokuk—Nothing decided until after April election.
Manchester—Prospects equal to 1915, but nothing decided yet. Will probably do four or five blocks of brick paving.
Maquoketa—"Loss of revenue from liquor licenses will greatly curtail improvements."
Marshalltown—More storm sewers.
Mason City—Will do $750,000 of public work in 1916.
Missouri Valley—Prospects better than for many years.
Pella—Well supplied with public improvements except paving. Will do some this year.
Sioux City—Fully equal to 1915.
Spencer—About same as 1915.
Washington—Not as much as in 1915.

Kansas—

Abilene—Increase in paving and water works improvements in this and neighboring cities and towns.
Arkansas City—Work looking better for all concerned. Will probably make more improvements than in 1915.
Atchison—Prospects better. Will do more paving.
Dodge City—About same as in 1915.
Fredonia—Prospects good for more paving than in 1915.
Great Bend—Prospects now about same as in 1915, but more paving is sure to follow.
Hutchinson—1916 will be a good year with more paving, business and residence building.
Iola—1916 will be a good year. Promotion of 20,00 more yards of pavement would be easy.
Lawrence—Paving about the same, sewer work double. $200,000 improvements in water works if bond election, March 14, carries, providing for purchase of plant.
Lyons—Prices for materials are so high that much contemplated work has been indefinitely postponed.
McPherson—Fully as much work as in 1915.
Neodesha—Will have more construction work, both public and private.
Ottawa—Not much paving in sight yet. More general construction work in other lines in prospect. Hands full of work same as last year.
Pittsburg—About same as 1915.
Rosedale—Expect to do more concrete paving than in 1915. Prospects for a very busy season.
Topeka—Will do twice as much paving as in 1915.
Weir—Will do 50 per cent. more good roads construction than in 1915.
Wellington—Will do more paving, storm water and sanitary sewers than in 1915.

Kentucky—

Carlisle—1916 will be about an average year.
Newport—1916 will be far ahead, $200,000 street work ready for letting in this and neighboring cities as against $60,000 in 1915.
Louisville—About same as 1915.
Paducah—Prospects much better than for 1915.
Paris—No plans for more than the usual necessary work.

Louisiana—

Kentwood—Little difference from 1915.
Patterson—Will do more road building and water connections.

Maine—

Bangor—Plans not yet made.
Gardiner—Plans not yet made.
Lewiston—Appropriations will be made in May. Work will be about the same as in 1915.
Saco—Election March 1. Plans made thereafter.
Van Buren—Expect to build considerable amount of streets and sidewalks, but appropriations are not made until last of March.

Maryland—

Cumberland—First election under new charter held in March. Public improvements can therefore not be predicted.
Frederick—About same as 1915; $30,000 a year maintenance and new streets and sewers.

Massachusetts—

Brookline—Appropriations not yet made.
Everett—Appropriations will be made in April and work laid out in May.
Great Barrington—Appropriations made March 27.
Greenfield—About same as 1915.
Haverhill—Appropriations not yet made.
Lawrence—Will do less than in 1915.
Malden—Appropriations not yet made.
Manchester—Prospects for municipal work excellent; for private work, poor.
Needham—Nothing definite until after March town meeting.
New Bedford—Will do more on both streets and sewers than in 1915.
Norwood—Will do more street paving than in 1915.
Orange—Will reduce tax rate.
Provincetown—About same as 1915.
Revere—Probably less than 1915.
Taunton—Appropriations not yet made.
Webster—Nothing definite until after annual meeting, last of March.
Westboro—About same as 1915.
Westfield—Appropriations made first Monday in April.
Winchester—Appropriations not yet reported.

Michigan—

Alpena—Changing to commission form of government this spring and prediction therefore difficult.
Ann Arbor—Will do less sanitary sewers; same storm sewers; more special construction.
Battle Creek—Will do more paving.
Benton Harbor—No program yet, on account of change in administration, April 1.
Detroit—Paving about the same; sidewalks, less; water works and sewers, more.
Dowagiac—New work not laid out until May 1.
Eaton Rapids—Prospects better than ever for paving and water works.
Flint—More work than ever before, due to rapid growth of city, requiring construction of nearly $1,000,000 worth of new factories and 3,000 new houses.
Grand Rapids—Not as much as last year. None of importance now in contemplation.
Greenville—About same as 1915.
Hastings—Appropriations made about June 1. Will do more paving.
Holland—More sewers, less paving.
Jackson—More than 1915.
Ludington—Prospects good; will probably do more in all lines.
Monroe—Petitions come in late, prediction therefore difficult.
Niles—No work laid out until after June 1, and organization of new council.
Onaway—Appropriations made May 1.
Petoskey—Prospects good. New city manager form to be installed in April.
Sault Ste. Marie—About same as 1915.

Minnesota—

Albert Lea—Will do more in paving and sewers.
Alexandria—Not as much as 1915. Nothing yet in sight.
Bemidji—More than in 1915.
Cloquet—Not as much as 1915.
Faribault—General prospects exceedingly good, especially for house construction. Public improvements about same each year.
Hibbing—Probably considerable paving, sidewalk and sewer work, but no plans made yet; $500,000 water system about completed.
St. Paul—Prospects very bright. Will do more work in all lines than 1915.
Sauk Center—Perhaps more than 1915.
Stillwater—Probably less than 1915, because of new council under new charter.
Thief River Falls—No work for for 1916 thus far.
Virginia—About same as 1915.
Willmar—About same as 1915 in sewers and water works.

Mississippi—

Vicksburg—May do more paving than 1915.

Missouri—

Columbia—About same as 1915.
Fulton—About same as 1915.
Independence—Paving, sidewalks, sewers, culverts, more than double 1915.
Jefferson City—Not as much as 1915. Petitions not yet in.
Kansas City—Special public improvements to be started in 1916 under $4,500,000 bond issue. Also $500,000 more regular assessed street and sewer improvement than in 1915.
Lexington—Not very good prospects.
Liberty—Prospects better. Bonds voted for sewers and more paving.
Pierce City—Not much to be done.
Poplar Bluff—Storm sewers principal work this year.
Sedalia—More paving and much more sewer work than 1915. Building will be less.
Webster Grove—Will do more construction work, particularly sewers, than in 1915.
Windsor—About same as 1915.

Montana—

Livingston—More paving contemplated, but not yet decided upon.
Miles City—Probably not as much as 1915, except in paving.

Nebraska—

Chadron—Better prospects for gravel streets, cement walks and curb.
College View—But little. Did large amount in 1915.
Gering—Better than any previous year.
Grand Island—Nothing definite until April 1.
Havelock—Will do more paving.
Lincoln—Will do much more than 1915.
Nebraska City—Not as much as 1915.
Red Cloud—About same as 1915.
Seward—More paving and water mains.
University Place—Will do something, not yet definite.

New Hampshire—

Laconia—Nothing definite. City election in March. Appropriations in May.

New Jersey—

Bayonne—Prospects good for paving. Probably 25 per cent. more than that listed.
Bloomfield—Prospects very good. Will do much work.
Bordentown—Will do some sidewalk work. Nothing else in prospect.
Cranford—Township about the same as 1915. Road appropriation, $15,000.
Elizabeth—More paving than 1915.
Glen Ridge—About the same as 1915.
Irvington—More than 1915, particularly large concrete storm drain.
Jersey City—May exceed 1915, except for scarcity of labor.
Long Branch—About the same as 1915.
Newark—Township will do three times as much as 1915 in paving, sewers and disposal plant.
New Brunswick—More than usual, particularly water works and paving.
Orange—Less than 1915.
Passaic—Less paving. Much more sewer work to adjust system to Passaic Valley main intercepting sewer.
Plainfield—Better than 1915.
Rahway—About same as 1915 in paving and sewers. Sewage disposal plant extra.
Ridgwood—Prospects better, particularly for permanent pavements.
Rutherford—Probably less than 1915.
Summit—May lay pavements, put in sewage disposal plant and pumps and storm sewer, but program not yet made.
Westfield—More than 1915 in sewers, if no scarcity of labor; $25,000 in park development.

New Mexico—

Albuquerque—Will start several large works this year.
Raton—Not as much as 1915, which was an exceptional year.

New York—

Albion—Prospects not as good as 1915.
Buffalo—About the same as 1915.
Carthage—Program not known until May. Probably same as 1915.
Dolgeville—Less sewers than 1915.
Dunkirk—Annual budget not available until April.
Ellenville—Same as 1915.
Elmira—Expect to issue $200,000 paving bonds later.
Geneva—Will not do 25 per cent. of 1915.
Glens Falls—Prospects much better, especially in water mains and street paving.
Gloversville—About the same as 1915.
Gouverneur—About the same as 1915.
Herkimer—No more than last year, unless water mains are laid.
Hornell—Program not yet available.
Hudson—More than 1915, especially in bituminous macadam.
Hudson Falls—About $3,000 for new work each year. Special work voted on in March.
Jamestown—Probably more paving.
Johnstown—Building prospects greatly increased.
Lackawanna—Not as much as 1915.
Little Falls—Paving indefinite on account of question about bond issue.
Lockport—Probably more construction, particularly buildings. Paving, sewer and water petitions not yet in.
Massena—No program yet on account of late eelction.
Niagara Falls—More than 1915 in sewers and water intersections.
Ogdensburg—Less than 1915.
Oswego—Paving about the same. Sewer construction, less.
Plattsburg—Plans not definitely decided, except as to $200,000 city hall and $250,000 memorial park to be started this spring.
Rensselaer—More work than 1915 in paving and school house construction.
Salamanca—About same as 1915.
Schenectady—Will do very little in 1916, owing to present high tax rate.
Utica—About same as 1915.
Watertown—About same as 1915.

North Carolina—

Burlington—Heavy expenditures: $50,000 to $100,000 for street paving, $30,000 for city hall, $38,000 for school houses, $65,000 for postoffice, $30,000 for office building.
Goldsboro—More improving of dirt streets will be done in 1916.

Greensboro—Prospects good. More sewer work, less paving.
Plymouth—Water works, sidewalks and sewers of 1916 are first public improvements to be made.
Rockymount—Most of the construction done in 1914 and 1915. No large work for 1916.
Wilmington—No work on hand except one gravel road.
Wilson—Water, gas and street improvements for 1916 amount to $410,000.

North Dakota—

Fargo—As good a year as they have ever had. As much paving and more sewer and water extensions.
Minot—As much or more than 1915.

Ohio—

Bellefontaine—Probably less than 1915.
Bucyrus—Probably ten times as much as in 1915.
Chardon—None, except new water works system this year, because of recent completion of sewer system and sewage disposal plant.
Chicago Junction—More than 1915.
Chillicothe—More street paving, less sewers.
Cincinnati—Council has not yet acted.
Conneaut—More paving.
Cuyahoga Falls—Much work in 1916. Completing street paving listed and more yet to be planned, three or four miles of trunck sewer with deep well excavation, seven to ten miles lateral sewers.
Dayton—Much more than 1915 in bridges, storm drains, sanitary lateral sewers, street paving.
Delaware—More in 1916, one or two streets not started yet.
East Palestine—Much more than 1915.
Fayette—About same as 1915.
Fostoria—Fewer contracts but more actual construction. Reservoir job larger than all 1915 work.
Greenville—More sewer work and less street work.
Lakewood—About same as 1915, $300,000, with $200,000 sewage disposal works additional.
Lancaster—About same as 1915.
Lima—More paving than any preceding year.
London—Too early to estimate 1916 work.
Lorain—More than 1915.
Marietta—Prospects for work rather better than 1915; depend on new council.
Middletown—About same as 1915.
Newark—Probably no paving in 1916.
New Comerstown—More, by the sewers listed in this table.
Niles—Not as good prospects. But little sewers or paving, owing to advance in cost of labor.
Norwood—Will have unusually busy season if bond issue passes in April as expected.
Painesville—About same as 1915.
Steubenville—Much lighter improvements than for past nine years, as city's financial condition is not satisfactory.
Toronto—More paving than 1915.
Wapakoneta—More sewers, less paving.

Oklahoma—

Bartlesville—More paving and park improvement and garbage disposal.
Enid—Much more sewer and sidewalk work; also water works enlargement and main extensions and concrete bridges, if bond issues carry.
Holdenville—More paving, sewers and sidewalks than in 1915.
Okmulgee—More paving and bridges.

Oregon—

Astoria—Three times as much, mainly pavements, walks and viaducts.
Coquille—Much better prospects than 1915. More street improvements, less water mains.
The Dalles—Very little in 1915.
Eugene—About same as 1915.
Klamath Falls—Probably very little in 1916.
Marshfield—Prospects much better, more paving, building and ship construction.
Pendleton—Will probably do some paving. Too early to estimate amount.
Portland—About same as 1915.
Salem—Probably more than 1915, but amount not yet certain.

Pennsylvania—

Altoona—More than 1915.
Bethlehem—Over six times as much paving as usual.
Bloomsburg—No action yet.
Blossburg—Less than 1915; no paving.
Carlisle—Less than 1915.
DuQuesne—General conditions better, but no provisions yet for public improvements.
Franklin—About same as 1915.
Freeport—Prospects better for street and sewer improvements.
Lock Haven—Nothing decided yet.
McKeesport—Local prospects not good.
Meadville—About same as 1915, $10,000 for city's share. If bond issue is passed, will spend $50,000 to $75,000 more in 1916, for paving and storm sewers.
Miners Mills—About same as 1915. Appropriations not yet made.
New Brighton—Plans not yet made.
Norristown—Much more than 1915.
Northampton—More concrete road construction than 1915.
North Braddock—About same as 1915, unless large storm sewer gets started.
Oil City—Probably much less than for ten or twelve years.
Portage—More street paving and sanitary sewers.
Rankin—Prospects very bright for more construction work in all lines.
Ridgway—Less in 1916 on account of large improvements during past three years.
Scottdale—Will be less paving unless bond issue should be decided on.
Waynesboro—More paving than 1915.
Williamsport—Program not yet decided on.
Wilkes Barre—Less than 1915.

Rhode Island—

Pawtucket—No plans yet.
Woonsocket—Much more street work than 1915.

South Carolina—

Bennettsville—Prospect good for general extensions and good business this year.
Charleston—Paving schedule not yet prepared.
Columbia—More sewer and water extensions, less street and sidewalk paving.
Sumter—None in 1915; $225,000 in 1916.

South Dakota—

Aberdeen—Not much public work anticipated. Prospects good generally.
Huron—Good increase over last year.
Mitchell—More paving; perhaps less sewer and water main construction.
Sioux Falls—More paving; same sewer expenditure; less water works improvement.
Yankton—More than in 1915, tho prices will be about 25 per cent. higher.

Tennessee—

Bristol—More streets and sidewalks than 1916; also reservoir and $60,000 high school.
Dyersburg—More street and alley paving, sewers, water mains, electric light extensions.
Fayetteville—Street plans not yet made.
Newport—More than 1915.
Paris—About same as 1915, city work. General prospects better.

Texas—

Greenville—About same as 1915.
Longview—Prospects better; more paving.
Orange—Will spend $150,000 on slips and docks.
Paris—About same as 1915.
Sulphur Springs—City less, but county much more than 1915.
Waxahachie—More sanitary sewers and water mains; less paving.

Utah—

Ogden—Less than 1915.
Provo—Probably more sidewalks, but less street paving. Program not yet complete.

Virginia—

Danville—Appropriations made May 1.
Harrisonburg—About same as 1915.
Staunton—Probably greater total.

Washington—

Camas—Improvements in the district very light for 1916.
Grandview—Conditions better, but very little public work in sight for 1916.
South Bend—Prospects better, but no city work for 1916; more private and county work.
Tenino—First six months not very promising. If lumber industry revives last half, better prospects.
Vancouver—Prospects poor for anything but necessities.
Walla Walla—Considerable more than 1915.

West Virginia—

Charleston—About the same paving as 1915. No sewers.
Moundsville—About same as 1915.
Parkersburg—Will lay about twelve times as much paving in 1916 as in 1915.
Wheeling—Plans not yet made.

Wisconsin—

Antigo—Water department, more work than in 1915. Other public improvements delayed by replacing of burned high school.
Appleton—Much lighter than 1915.
Ashland—Prospects good. Program not yet completed.
Beloit—Same as 1915 with additional bridge work.
Chippewa Falls—Not as much as 1915.
Eau Claire—Less in all lines.
Janesville—About the same as 1915.
La Crosse—Less than 1915.
Madison—About same as 1915.
Manitowoc—More paving and building in 1916.
Marshfield—About same as 1915.
Menasha—More street work in 1916.
Oshkosh—About same as 1915.
Pt. Washington—Program not made until May 1.
Racine—More paving, less sewers.
Waukesha—About same as 1915.
West Allis—Too early to make estimate. Probably much more paving, less sewer and water work.

Wyoming—

Laramie—More paving, less other work.

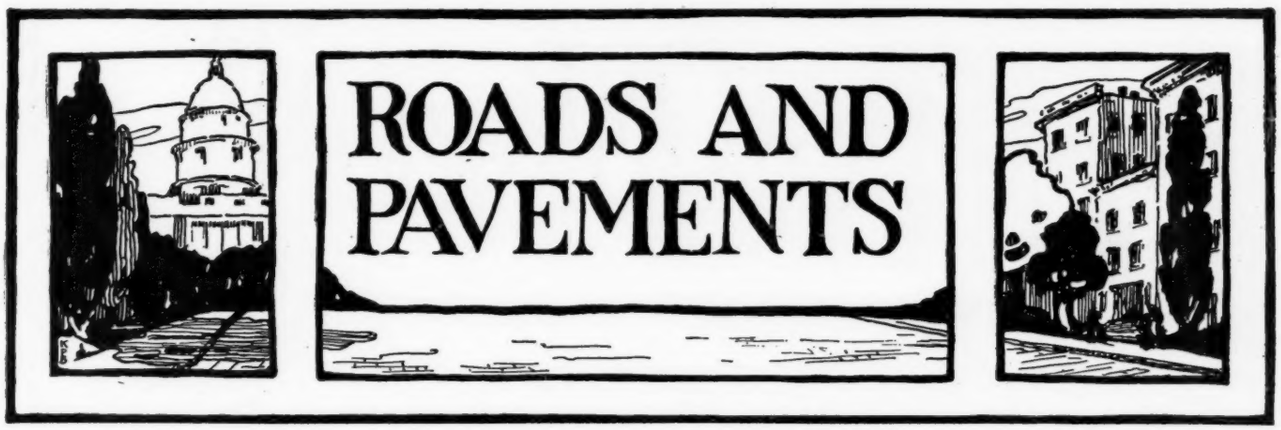
CANADA—

Alberta—

Calgary—Not so large in 1916.

Ontario—

Hamilton—Owing to the war, will do as little construction work as possible.
Ottawa—Owing to the war, will do as little construction work as possible.
Regina—Complete program not yet determined. Probably about same as 1915.
St. Catherines—Prospects better than 1915.
Stratford—Labor market will control amount of work. Otherwise prospects good.



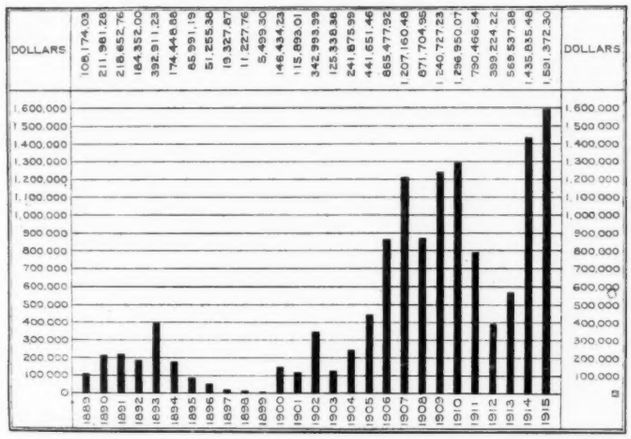
Municipal Improvements in Salt Lake City

The diagram shown here is from the annual report of the city engineer of Salt Lake City, Utah, just completed. It illustrates in graphic style the story of public improvements in Salt Lake during 1915. as compared to the records of other years.

As the engineer observes in his report, and as the diagram plainly indicates, the year 1915 witnessed more extensive public improvements in Salt Lake than any previous year in its history. In addition to the $1,591,372.30 actually expended, other contracts were let, but not completed in 1915, amounting to $347,014.39, bringing the total cost of public improvements completed and undertaken during the year close to the two million dollar mark.

The improvement program included 66.5 miles of sewers. practically one-third of the entire sewage mileage previously laid, including the great outlet sewer now in process of con-

DIAGRAM SHOWING COST OF PUBLIC IMPROVEMENTS.



struction; the great storage reservoirs in Big Cottonwood canyon, the Fifth South street and the City Creek equalizing reservoirs and additional supply and distributing mains; six and three-tenths miles of pavement, nearly five miles of curb and guttering, and nearly nine miles of sidewalks.

The extent, cost and nature of public improvements during the year are shown in the following statement:

1.823	miles of water supply mains	$ 33,501.00
9.969	miles of distributing mains	67,183.00
2.825	miles of bitulithic pavement	132,051.72
0.688	miles of bituminous concrete pavement	33,756.77
0.300	miles of sheet asphalt pavement	14,445.61
2.402	miles of Utah rock asphalt pavement	170,153.62
0.108	miles of concrete pavement	3,848.12
8.854	miles of cement sidewalks	28,444.78
4.881	miles of curb and gutter	71,446.23
7.293	miles of sewer mains	318,544.45
59.258	miles of sewer laterals	520,462.56
1.066	miles of storm sewers	14,530.55

Treatment of Wood Paving Blocks at the Consumer's Point

The market for wood block paving has been amazingly increased by a new type of treating plant which by its simplicity makes it possible to treat the blocks near the consuming point, thus cutting the freight rates which had previously added materially to the cost of the superior wooden block paving in many parts of the country. The new type of treating plant is a vertical cylinder, which can be adapted to handling other material than wooden blocks, and so be used to treat material for the retail trade, such as the smaller dimension timber, silo stock, bridge material and farm timbers.

, The new type of cylinder, developed by two engineers working separately along similar lines, J. B. Card, of Chicago, and G. B. Shipley, of Pittsburgh, has as its chief advantage its low first cost and its simplicity of operation. Only two machines are required, with much smaller tanks and cylinders, thus permitting the construction of paving block plants in connection with saw mills or near consuming points. Freight rates on shipments of blocks to remote territory may thus be eliminated, making it easier to meet the competition of other paving materials. In many localities the cost of wood block has been high, owing to the long freight haul. The new treating method appears to meet this difficulty, and will thus make possible the use of southern pine in the south, tamarack in the north, and fir on the Pacific Coast, or any other wood suitable for pavement.

Good Roads Notes

Of 300 miles of pavement in Columbus, O., 193 are of vitrified brick.

Increase of business outside the city by 65 per cent. on account of motor-truck delivery is reported by the Globe Furniture Co., of Fond du Lac, Wis., some deliveries being made as far as 45 miles from town. This is an indication of the enormous use which will be made of motor trucks for carrying products from the farm and purchases back to the farm as well as to other customers, which will develop just as fast as the roads become good enough to stand the strain. The Kissel-Kar truck shows its ability to stand the strain even when the roads are not the best, by means of such reports as the above.

FIRE DEPARTMENT

Progress in Fire Motorization

The city of Youngstown, O., has nineteen pieces of motor fire apparatus in service, covering four makes. Chief Joseph Wallace submits the following costs, covering one piece, as typical:

Period of time—From January 1, 1915, to January 1, 1916.
Type of motor fire apparatus—Triple combination.
Name of make—Knox.

Cost of repairs, including labor and material	$162.60
Cost of gallons of gasoline	45.65
Cost of gallons of oil	4.00
Cost of gallons of grease	1.75
Miscellaneous expense, batteries recharged	7.20
Total cost	$221.20
Distance traveled (miles)	696
Number of alarms answered	253

Youngstown has had no horses in its fire department for the past two years.

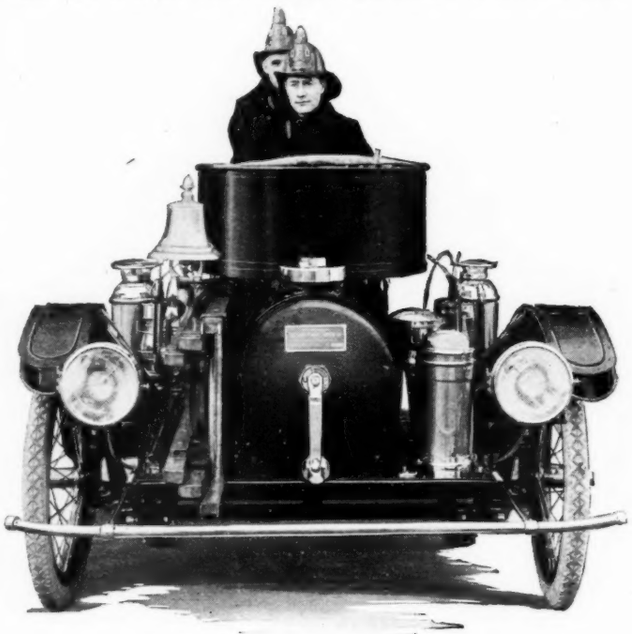
Do Away With Twelve Horses.

T. C. Collins, chief engineer, fire department, Cohoes, N. Y., states:

"We have four pieces, all placed in service February 1, 1915: A triple combination with 800-gallon pump, a combination chemical and hose wagon, a 4-wheeled tractor attached to a 75-foot aerial truck and a 2-wheeled tractor attached to a second size Metropolitan engine. These four machines take the place of 12 horses and we find that it costs us approximately 75 cents a day per horse, or $9.00 for the twelve, or $3,285 for the year. Our total expense for the care of the four motors for the year ending February 29, was $311.14. This includes gasoline, oil, grease and such minor repairs as became necessary."

Low Cost Per Mile.

"The city of St. Cloud, Minn.," states Chief L. A. Moosbrugger, "expended the sum of $14.53 on its motor fire apparatus in the year 1915. Our truck covered 113.6 miles in going to fires and 10.03 in practice runs. In fire runs 90 gallons of gasoline and 4.6 gallons of oil were used at a cost of $13.17, while the practice runs cost $1.36, making a total of $14.53."

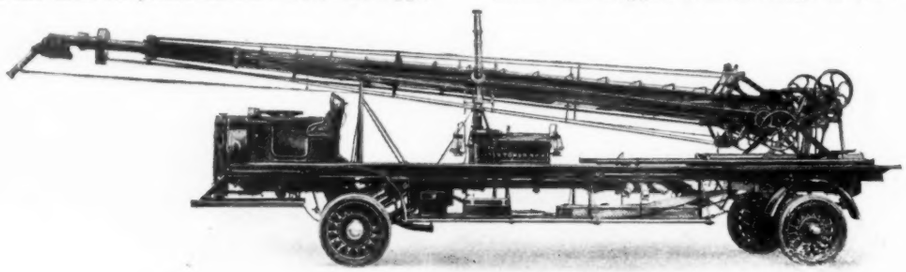


DAYTON TRI-CAR CHEMICAL.

Turns River Into Fire-Fighting Stream.

Power of the White fire apparatus owned by East Machias, Me., to convert water from a river into a powerful and steady stream despite hills or lifts up which hose must be laid was recently demonstrated.

Hose was dropped from a bridge to the water level, making



AMERICAN LA FRANCE WATER TOWER.

a lift of 20 feet. The nozzle was a one and one-quarter. The engine started and the draft was perfect, throwing 508 gallons a minute.

On another occasion water had to be drawn from the river to the top of a hill about a half mile away. The apparatus overcame the conditions and threw a solid stream. Needless to say East Machias has put faith in this machine and feels certain that it is equal to any emergency that may arise.

More Mileage at Less Cost.

Chief Nathan Bradfield, La Crosse, Wis., submits the following table covering costs of motor combination hose and chemical as compared with similar horse-drawn outfit. In answering thirty-seven alarms, the motor-driven outfit traveled 103.3 miles, while, in answering twenty-three alarms, the horse-drawn apparatus traveled 50.2 miles:

AUTO APPARATUS.

95 gallons gasoline	$ 10.55
6 gallons oil	1.76
5 gallons grease	.60
1 can 3-in-1	.25
Total	$ 13.16

HORSE-DRAWN TRUCK.

Feed	$ 74.21
Shoes	27.60
Harness repairs	.60
Total	$102.41

Big Saving Over Horse Equipment.

According to figures compiled by Chief William E. Markwith, East Orange, N. J., which has a population of 34,371, according to the 1910 census, the motor apparatus now in use represents a saving for 1915 over the cost of maintaining horse equipment of $1,681.51.

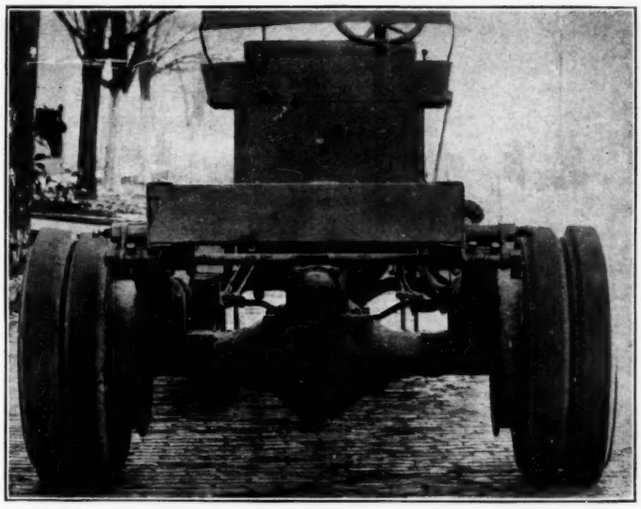
The records show that the chief's automobile covered 2,448 miles during the year at a cost of $118.74. As it would have cost $17.60 a month to keep a horse, or $211.20 for the year, the saving was $92.46. The mileage of the White motor truck for the same period was given as 269½, at a cost of $52.97, whereas the maintenance of three horses would have amounted to $633.60, and thus the saving was shown to be $580.63.

The White Motor Chemical No. 5 covered 204.2 miles and cost $22.72 for maintenance which, deducted from the cost of keeping three horses, gave a saving of $610.88. Motor Chemical No. 5, which traveled 329.8 miles in the year, cost $24.86, against the maintenance of two horses amounting to $422.40, and was, therefore, credited with a saving of $397.54.

A Concord, N. H., Record.

Chief Green of the Concord, N. H., fire department has compiled some figures showing the cost of motor-driven and horse-drawn fire apparatus, which are decidedly interesting.

The figures cover the cost for the year ending January 1, and in order to be strictly fair, the Chief says: "It should be borne in mind that the presence of an epidemic during the last three months of the year among the horses made the maintenance expensive, while the fact that the machine, being new,



REAR VIEW SOUTH BEND TRACTOR.

required no very extensive repairs, militated to the advantage of the same. But with both of these factors eliminated, the margin in favor of the auto appears to be too large to admit of further doubt as to which can be used to advantage. Aside from the financial saving, the saving in time in responding to alarms, an important feature, should be given full consideration.

"It cost to maintain the fifteen horses in the department for the year $2,592.58, $1,801.48 of which was for forage and $298.70 veterinary bills. The cost per horse was $172.84. The cost of transporting each two-horse piece of apparatus was $345.68, and of the three-horse trucks, $518.52. The cost of transporting the motor was $90.17.

"The Robinson combination traveled 542 miles on 252 gallons of gasoline, 17 gallons of oil and 100 pounds of grease. The materials used at fires were 734 pounds of soda, at two cents per pound, 434 pounds of vitriol, at three cents a pound, and 274 pony extinguisher bottles, at seven cents each, making a total cost of $46.88, and bringing the total cost of the operation of the motor to $137.05."

Urbana, Ill., Costs.

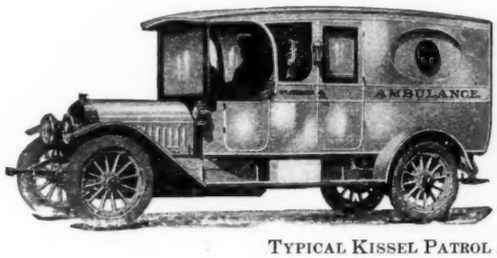
The property of the fire department, Urbana, Ill., consists of two Seagrave motor combinations, chief's auto, horse-drawn ladder truck and four horses. The department contains five men, including the chief. Following appear the motor and horse-drawn costs of this department for a period of twelve months:

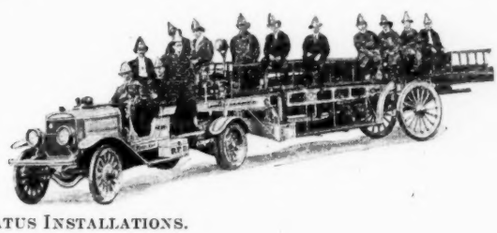
HORSE-DRAWN.

Feed and bedding	$288.05
Horseshoeing	33.75
Repairs	5.10
Total	$326.90

MOTOR-DRIVEN.

Gasoline	$ 12.75
Engine oil	2.63





TYPICAL KISSEL PATROL AND FIRE APPARATUS INSTALLATIONS.

Prest-O-Lite	8.00
Dry cells	2.00
Repairs	1.50
Total	$ 26.80

CHIEF'S CAR.

Gasoline	$ 18.42
Engine oil	5.27
Dry cells	6.00
Repairs	28.50
Total	$ 57.91

Norwich, Conn., Test

The following figures cover results of test, of a Seagrave Pumper, submitted by Chief H. L. Stanton, Norwich, Conn.:

Engine—6 cylinder, 5¾ x 6½.

Pump—4 stage centrifugal.

Gear Ratio—Engine to pump—1 to 2.06.

Contract Requirements: 750 gallons a minute at 120 pounds net pump pressure; 600 gallons a minute at 160 pounds net pump pressure; 450 gallons a minute at 200 pounds net pump pressure; 375 gallons a minute at 250 pounds net pump pressure; 150 gallons a minute at 350 pounds net pump pressure.

Tested at: Draft from river.

Life: 7.7 to 9.6 feet.

First Test—Duration: 30 minutes. Layout of hose and nozzles: One line of 2½-inch hose, 300 feet; 1-inch nozzle. Average discharge and pressure: 413 gallons at 265 pounds net pump pressure. Remarks: Satisfactory.

Second Test—Duration: 30 minutes. Layout of hose and nozzles: One line of 2½-inch hose, 150 feet; 1¼-inch nozzle. Average discharge and pressure: 517 gallons at 211 pounds net pump pressure. Remarks: Satisfactory.

Third Test—Duration: 2 hours. Layout of hose and nozzles: Two lines of 2½-inch hose, 100 and 150 feet; 1¾-inch nozzles. Average discharge and pressure: 774 gallons at 127 pounds net pump pressure. Remarks: Satisfactory.

Fourth Test—Duration: 6 minutes. Layout of hose and nozzles: Two lines of 2½-inch hose, each 250 feet; 1½-inch nozzle. Average discharge and pressure: 638 gallons at 173 pounds net pump pressure. Remarks: Satisfactory.

Fifth Test—Duration: 5 minutes. Layout of hose and nozzles: One line of 2½-inch hose, 700 feet; 1-inch nozzle and discharge gate partly closed. Average discharge and pressure: 150 gallons at 360 pounds net pump pressure. Remarks: Satisfactory.

General Remarks: Satisfactory.

Advocating Pulmotor Car

Many prominent fire engineers are advocating a pulmotor car. In other words, it is being quite strenuously recommended in many quarters that an up-to-date pulmotor be kept in the chief's or first assistant chief's motor car for emergency purposes.

Arthur S. August, fire chief, East Liverpool, Ohio, submits the following pulmotor runs answered by the chief's car:

May 16, 12:02, Alton and Hubbard Sts., electric shock received by Edgar Vess, 11 years old, used pulmotor 5 minutes, saved boy's life.

May 21, Newell, W. Va., drowning and shock, Mrs. Susie Clynoggle jumped from bridge, death was caused by jump, used pulmotor 45 minutes, no results.

July 12, Fredericktown, drowning, Miss Katherine Martin, in water 4 hours, pulmotor used 2 hours, no results.

July 22, Dresden Ave., shock by telephone wire. Little girl, name not learned, did not use pulmotor.

August 4, Seventh and Monroe, cave-in, name unknown, revived without using pulmotor.

August 9, Wellsville, O., drowning, name unknown, could not find body, did not use pulmotor.

September 23, West Eighth St., heart failure, lady unknown, used pulmotor 40 minutes, no results.

September 25, Pennsylvania Ave., automobile accident, name unknown, did not use pulmotor.

September 4, Erie St., heart failure, E. Robinette, pulmotor used 45 minutes without results.

December 6, Gardendale, drowning, Edgar Davis, used pulmotor 10 minutes and saved boy's life.

As will be seen, two lives were saved by the use of the pulmotor. In most of the cases the time that elapsed before calling or persons being in the water was too long, but the pulmotor was used so that there would be no doubt.

Stands Severe Test Nine and a Half Hours

No motor fire apparatus ever received a more severe test than that given the New Bedford, Mass., equipment at the recent Fall River fire. The fire attacked the business district and threatened the city with disaster. Fire Chief Edward F. Dahill, of New Bedford, was among the first to offer the service of fire fighters from neighboring municipalities. Shortly after midnight he gave the order to his men to hurry to Fall River. The roads were covered with ice and snow. The sky, by its wide area of reddish hue, indicated that the flames were spreading. The firemen realized that the motor apparatus had the battle of its career ahead.

The apparatus, a combination chemical and pumping engine, built by the White Company, of Cleveland, at thirteen minutes past midnight, left its station and thirty-seven minutes later was connected to a hydrant at Main and Anawan streets, Fall River. Credit has been given the New Bedford firemen for stopping the conflagration on the east side of South Main street and for helping save St. Mary's Cathedral. Chief Dahill and his men stayed on the job until 6 o'clock, and at the end of that time the White machine had pumped steadily for 9½ hours. How it stood this pumping test, how it stood the bad road test, is best told by Captain James Mahoney in an interview given the newspapers after the fire.

"The roads were icy, but the trip from New Bedford to Fall River was made without incident, the big machine holding the road well. No motor apparatus was ever asked to take the road under more unfavorable winter road conditions. We arrived in record time, considering conditions, and went to work at once. For 9½ hours the White engine pumped and not once was there even the slightest trace of a skip. This showing not only demonstrates the power and efficiency of the engine, but also reflects creditably on the care the apparatus receives. We went home tired but happy and mighty proud of our apparatus."

Henry Mayer, fire marshal of Bloomington, Ill., joined the fire department as a call man in 1881. He was promoted to be engineer of a chemical engine in 1887 and to be chief in 1895, so that he is now serving his twenty-first year in that position. He has seen one conflagration due largely to the lack of proper water distribution system, and the small horse-drawn department of the time before the fire has become a modern, up-to-date motorized department of high efficiency.

MISCELLANEOUS

The March of Events

April 12, Portsmouth, O. The Institute of Paving Brick Manufacturers. W. G. D. Orr, chairman of program committee.

April 19 to 22, at New York City. First National Conference on Community Centers and Related Problems. John Collier, secretary, 70 5th Avenue, New York.

April 18 to 21, at University of Illinois, Urbana, Ill. The American Chemical Society will meet and hear final report on methods of analysis of sewage and water and discuss activated sludge.

May 2, 3, at Park Hotel, Williamsport, Pa. Pennsylvania State Chiefs of Police. Geo. W. Harder, secretary, Williamsport, Pa.

May 8 to 10, at Waco, Tex. Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Tex.

May 9, 10, 11, at Auditorium of Insurance Exchange, Jackson and La Salle Sts., Chicago, Ill. Annual meeting of National Fire Protection Association. Franklin H. Wentworth, secretary, 87 Milk St., Boston, Fass.

May 10 to 17, at Indianapolis, Ind. National Conference of Charities and Corrections. Central office, 315 Plymouth Court, Chicago, Ill.

May 31 to June 2, at Syracuse, N. Y. New York State Conference of Mayors. Mark E. Conan, comptroller, Syracuse.

May 31 to June 2, at Syracuse, N. Y. National Association of Comptrollers and Accounting Officers.

June 4 to 8, at New York City. American Water Works Association. J. M. Diven, secretary, 47 State St., Troy, N. Y.

June 15, 16, at Cleveland, O. Ohio Society of Mechanical, Steam and Electrical Engineers. Joseph L. Skelton, president, Toledo, O.

June 28 to 30, at Battle Creek, Mich. Michigan League of Municipalities.

July 9 to 13, at Detroit, Mich. Wold's Salesmanship Congress. Walter C. Cole, secretary, Board of Commerce Bldg., Detroit, Mich.

July 11 to 13, at Goshen, Ind. Municipal League of Indiana.

August 7 to 9, at Houston, Tex. City Marshals' and Police Chiefs' Union of Texas.

September 6 to 9, at Newark, N. J. League of American Municipalities.

September 13 to 15, at Portland, Me. Convention of New England Water Works Association. Willard Kent, secretary, Narragansett Pier, R. I.

October 9 to 13. at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Bldg., Indianapolis, Ind.

October 16 to 21, at Detroit, Mich. National Safety Council holds its annual safety congess. W. H. Cameron, secretary, Continental and Commercial Bank Bldg., Chicago, Ill.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

April 12, 13: Computer and Estimator, in office of Supervising Architect, Treasury Dept., at $1,600 a year.

April 12: Junior Engineer, in Engineer Department, War Department.

April 18: Assistant Petroleum Engineer, Bureau of Mines, for service in field, at $1,800 to $2,500 a year.

April 18: Engineer Economist, in Office of Public Roads and Rural Engineering, at $2,000 to 2,500 a year.

April 18: Mechanical and Electrical Inspector, at Naval Proving Grounds, Indian Head, Md., at $6.72 a day.

April 19: Junior Signal Engineer and Junior Structural Engineer, under Interstate Commerce Commission on railroad valuation, at $1,200 to $1,680, and $720 to $1,080 a year.

April 25: Electrical Draftsman, in Bureau of Steam Engineering, Navy Department, at $5.04 a day.

May 2: Mechanical Superintendent in Department of Agriculture, Washington, D. C., at $2,500 a year.

May 2: Associate Engineer Physicist, in Bureau of Standards Department of Commerce, at Washington or Pittsburgh, at $2,000 to $3,000 a year.

May 3: Laboratorian qualified in electrical science, in Mare Island navy yard, Cal., at $3.60 a day.

August 21 to 25: Second Lieutenant from civil life, from those qualified as junior engineers, Engineer Department, War Department.

The Philadelphia, Pa., Civil Service Commission will hold examinations as follows.

April 17 to 20: Draftsmen, City Transit Department, bridge division, $600 to $1,200 a year.

April 26: Tracer, City Transit Department, $600 a year.

May 3: Transitman, City Transit Department, 1,200 to 1,500 a year.

May 4, 5: Assistant Engineer, Surveys Bureau, Department of Public Works, at 2,500 a year; also Structural Draftsman, at $1,200 to $1,500 a year.

Technical Organizations

The American Association of Engineers is growing rapidly its membership now being 500. Its employment bureau shows great activity and, at last report, had thirty unfilled positions

at salaries of $1,200 to $5,000 a year and only four of its members unemployed.

The National Americanization Committee, 18 W. 34th St., New York City, has instituted a competition for workmen's houses under four problems, each of which has a first prize of $300 and a second prize of $100, with an additional prize of $200 for excellence of construction. Drawings must be delivered at the office of the committee before noon on June 1. Full particulars will be given on request by the secretary. There is also a competition for plans for a substitute for the derailed freight car now used to house railroad construction gangs, with prizes totaling $600.

The New Hampshire Good Roads Association has been organized with Ovid F. Winslow, Nashua, N. H., as president, George P. Winn, Nashua, as secretary, and a full list of vice-presidents and directors.

Technical Schools

Highway Bulletin No. 1 of Purdue Univ., Lafayette, Ind., is on the maintenance of Indiana Highways, by Geo. E. Martin, C. E., assistant professor of highway engineering in the School of Civil Engineering.

"Smoke Abatement" is the title of a bulletin of Purdue University, by C. H. Benjamin, dean of the Schools of Engineering.

The catalog of Worcester Polytechnic Institute, Worcester, Mass., gives full descriptions of facilities and courses and a register of graduates. Ira N. Hollis, Pres.

Columbia University will hereafter confer the degree of Master of Science upon graduate engineering students who satisfactorily complete the Graduate Course in Highway Engineering. From 1911 to 1915, the graduate engineering students who have specialized in highway engineering have been candidates for the degree of Master of Arts.

The announcements of the Division of Chemistry, Columbia Univ., New York, for 1916-17 are included in a recent bulletin of the university.

Supply Department Recommended for Boston

The Boston Finance Commission has recommended that the supply department of Boston be enlarged so as to include the purchases of all departments. This follows an investigation into floor preservatives used by the several departments, involving charges that the materials were charged for at excessive prices and were not of standard quality.

Milford Will Not Purchase Lighting Plant

A committee, for which William Plattner acted as consulting engineer, reported recently upon the purchase of the plant of the Milford Electric Light and Power Co. The result of the report was an offer of the company to make a more advantageous contract with the town for lighting it with modern lights, and on recommendation of the committee and Mr. Plattner the town meeting of March 20, voted the committee authority to make a contract with the company for from two to five years on the new terms.

Personal Notes

Paul Hansen is now in charge of the Engineering Bureau of the Illinois State Board of Health at Springfield. He was recently with the State Water Survey at Urbana and before that was connected with the state health departments of Kentucky and Ohio.

Sylvester Q. Cannon has been reappointed city engineer of Salt Lake City, Utah, under the new commission form of government.

B. C. Brennan is re-elected for the fourth term as city engineer of Kenosha, Wis.

John L. Collins, consulting engineer, New York, will supervise plans and construction of sewers and sewage disposal plant for Sussex, N. J.

Ernest McCullough, consulting engineer, Chicago, is the chief engineer of the fireproof construction bureau of the American Association of Portland Cement Manufacturers.

Joseph P. Bayne, who has been in the employment of the engineering department of Cleveland, O., for thirty years, has resigned to take charge of the paving department of the Cleveland Railway Co. He began as rodman and moved up to the head of the paving department, which position he has occupied since 1899. From a city with a few main thorofares paved with Medina stone, he has had a large share in developing 556 miles of paving, 420 miles of which are of brick. F. W. Williams is his successor in the city paving department.

Max Harris Wilensky has opened offices in the Bailey Bldg., Philadelphia, Pa., for the practice of law.

Daniel W. Mead and F. W. Scheidenheim have opened offices as consulting engineers on hydraulic and electric developments, water supply and reclamation works, in the Equitable Bldg., 120 Broadway, New York.

J. W. Mercer has been appointed county engineer of Lucas county, Iowa.

Harold Bargeman has been appointed county engineer of Maricopa county, Arizona.

Ray Vosler, formerly city engineer of Greenville, Pa., is now with the Carnegie Steel Co., at Youngstown, O.

Frank E. Weymouth is the new chief of construction of the U. S. Reclamation Service. He has been a part of the Reclamation Service organization since 1902.

Publications Received

"Water Purification Plants and Their Operation," by Milton F. Stein, assistant engineer of design, Cleveland filtration plant, is a manual primarily for operators of water purification plants, also of interest to water works chemists and engineers, containing instructions for making chemical and bacterial tests, handling coagulants, washing filters and keeping records, with chapters on the processes of coagulation, sterilization, water softening and sedimentation, and descriptions of existing plants and useful charts for solving graphically problems relating to chemical tests and the application of coagulants; $2.50, net. John Wiley & Sons, New York.

A "Comprehensive Plan of Newark" is presented by the City Plan Commission of Newark, N. J., who had the aid of George B. Ford and E. P. Goodrich, expert architectural and engineering advisers, a number of architects and publicists on special investigations and the officials of the engineering, construction and health departments of the city. The report is the most suggestive yet published and is worthy of close study by those interested in the preparation of similar reports.

A report on market system for New York City and open markets established in Manhattan is issued by Marcus M. Marks, president of the boro of Manhattan and chairman of the committee on markets of the board of estimate and apportionment. In addition to the report about the open markets established in Manhattan and the results therefrom, there is a brief report of an open market in the boro of Richmond. Various persons report on the market conditions in Paris, London, Berlin, Hamburg and Cologne, giving in the German report regulations, forms of price lists, schedules of charges, rules for auctioneers, etc.

"West Point in Our Next War" is the title of a book, with a sub-title, claiming that the only way to create and to maintain an army is set forth in it. The author is Maxwell Van Zandt Woodhull, A. M., late Lt-Col. and Asst. Adj.-Gen., 15th Army Corps and Army of the Tennessee, Bvt. Brig.-Gen., U. S. V. The publisher is G. P. Putnam's Sons, New York, and the price is $1.35 by mail.

MACHINERY AND SUPPLIES

How a Contractor Handles State Highway Work

By D. G. Bevis, C. E.

On certain types of roads the equipment used and the methods of construction gradually become standardized. Nevertheless, a modern highway construction plant and the method of handling the work economically depend very largely upon the conditions encountered. While the concrete highways which have been built by the state of California and several of the counties during the last few years have in general followed the same specifications, the conditions confronting the contractor have varied widely. Two given contracts of approximately the same mileage may require totally different methods of handling the work, depending upon the amount and character of excavation, soil conditions affecting shaping the roadbed and keeping it in condition for receiving the pavement, length of haul of materials and character of the soil over which it must be hauled, water conditions, etc.

On their 10-mile state highway contract for cement-concrete pavement in Tulare county, the contractors, White & Gaskill, of Long Beach, have, after careful investigation of the conditions affecting handling the work, put in a modern and complete equipment plant, which they have found to be both economical and best adapted to the quick handling and transportation of their materials.

This contract called for 30,000 tons of material to be transported an average haul of 1¾ miles. The country over which it was to be hauled was level but the soil was found to be very difficult to haul over by wagons and the us eof trucks was discovered impossible. It is also such that no hauling by wagons could be done after a rain until the ground had thoroly dried out. The sub-grade would cut up too freely under a team load.

On previous contracts these contractors had been using standard methods as practiced in California and were thoroly familiar with the advantages of the motor truck and dump wagon, which in hauling have become standardized. But the conditions confronting them on this contract were such that they were not satisfied with the hauling methods with which they were familiar. They made a careful survey of the methods employed by eastern contractors and found that the portable railroad was taking the lead and was being generally used by the most successful contractors of the east. Altho they were confronted by the fact that they did not have the large tonnage which they found in most cases where railroad equipment had been used, after careful consideration they decided that the purchase of a portable railroad would be both economical on this contract and a good investment in equipment for future operations. Their order was placed with the F. F. Foster Co., Inc., for a "Lakewood System."

The hauling plant being used consists of more than four miles of 20-pound, 24-inch-gage sectional track; twenty-one 2½-cubic-yard-capacity Lakewood "V" dump cars, together with the necessary switches and curved sections. To this they added a 5-ton gasoline locomotive to displace teams for power. This locomotive is a German make known as "Otto." It had been purchased several years ago by an amusement company whose project never materialized, and the locomotive has since been in storage. It was purchased much under the original cost to the first purchasers. It has only one cylinder and is rated at 12-h.p., yet it is said to be doing the work of a 35-h.p. ordinary engine. It hauls a load of fourteen cars, aggregating 33 tons, at 5 miles per hour, and makes a speed of 10 miles per hour with the train without load.

The material is being shoveled directly into the cars, which are set alongside the steam railroad siding. On account of several sharp curves and heavy grades and their having had to go thru a culvert under the steam railroad, it was decided to use a team to haul the cars around onto the straight-away main line. The team haul is about 2,000 feet. After the first 4-mile section is completed, the teams will be eliminated, as the locomotive will haul directly from the switch. The team is now also picking up the empties and places them at the siding. One team will handle each eight hours 142 tons over this haul of 2,000 feet without difficulty. The contractors expect soon to be taking the sand from a pit instead of shipping it in. In this case it will be loaded over a trap by slip scrapers directly into the cars. These cars will be picked up by the team and placed upon the main line.

From the main line siding the gasoline locomotive takes fourteen cars to a trip, hauling the same to be dumped upon the sub-grade. The locomotive will handle 142 tons each eight hours on a haul of three miles.

The shoulders are made while the rough grading is done. The portable track is laid upon the shoulders just far enough from the headers so that the cars will dump upon the sub-grade.

One man, called the material man, takes care of the spacing of the material and can dump a car without assistance. While he is not busy on this, he is used on the sub-grade, which is rolled by an Austin gasoline road roller.

Since it is necessary to have 125 yards of material or more for each day's run of the No. 10 Chicago paver, they are compelled to work overtime on this work. The paver averages about 700 linear feet of pavement per day. However, this may be changed in the future and teams used to pull the cars to make the capacity sufficient in an 8-hour shift. One team of "4 Up" will handle ten 1½-yard cars on this contract, as it is a straight track without grades.

The great saving, aside from the great reduction in cost per ton-mile, of the "Lakewood System" over the team or truck haul, are of two varieties. First, after the sub-grade is made there is not a load hauled over it. It is never disturbed. This makes a saving of $250 per mile. Second, the hauling can

progress even during a rain. It is never necessary to stop on account of wet ground. This saving depends upon how much the contractor is pressed for time.

A transportation superintendent has complete charge of the railroad and the alinement of the track.

The costs of these various men and operations are as follows:

The cost per mile of hauling and laying the rail was about $90.

The track foreman is paid $5 per day, the locomotive engineer $4 per day, and the material man $4, helper $2.

The cost of the railway equipment, including the gasoline locomotive, was $14,000.

The team hauling from the switch cost $4 per day.

The gasoline locomotive consumes 12 gallons of distillate per day and two quarts of oil.

The total cost per day of operation of gasoline locomotive train is $5.40 for 142 tons hauled three miles.

The cost of unloading is 10 cents per ton.

The following is the record for three days' hauling:

LOG OF HAULS.

December 12, 1915.

Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	14	4	10	sand
2	11	1	10	sand
3	14	13	1	rock
4	14	1	13	rock
Total	53	19	24	

Total yards, 73½; total tons, 110; total expense, $16.40; distance hauled, 3 miles.

December 13, 1915.

Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	12	6	6	rock
2	11	9	2	rock
3	12	6	6	rock
4	12	6	6	rock
5	10	9	1	sand
6	10	1	9	sand
Total	67	37	30	

Total yards, 96½; total tons, 142; total expense, $16.40; distance hauled, 3 miles.

December 14, 1915.

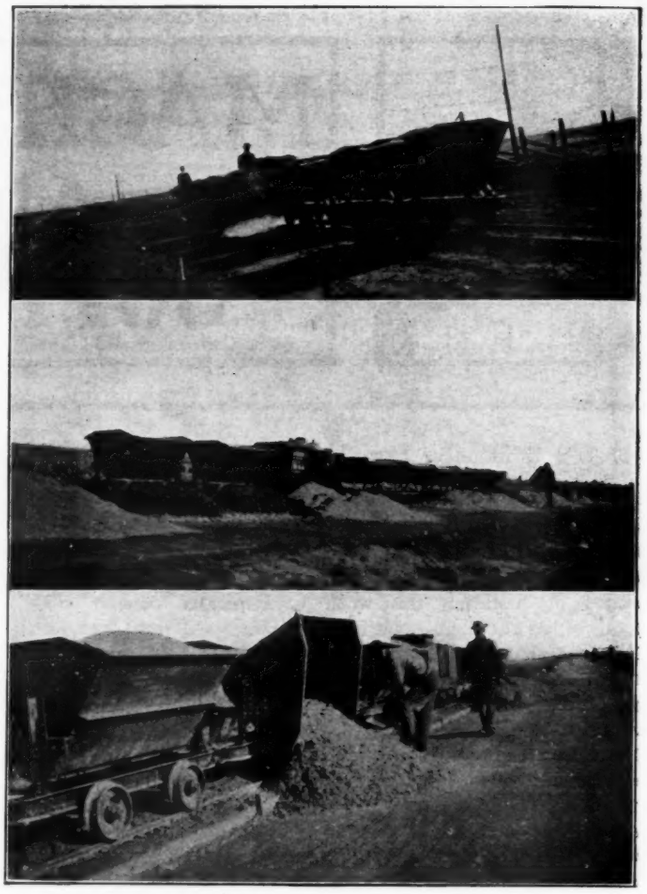
Trip	Total Cars	1½-yd. Cars	1 1/3-yd. Cars	Material
1	12	5	7	sand
2	12	6	6	sand
3	12	5	7	sand
4	11	9	2	sand
5	12	7	5	rock
6	12	3	9	rock
7	11	5	6	rock
Total	82	40	42	

Total yards, 116; total tons, 174; total expense, $16.40; distance to be hauled, 3 miles.

Note.—The "total expense" includes locomotive engineer, fuel and oil, track foreman, material men, assistant material men. This labor includes the complete operation of the locomotive hauling, including the maintenance of the track and the dumping of the material on the sub-grade.

White & Gaskill feel that they eliminated a lot of grief by purchasing the railroad, and no doubt will pay for the same out of savings of two contracts. They are handling all the work except grading, which is sublet to local parties.

The camp which these contractors have established is



LAKEWOOD CARS *on California road job.*

spoken of by all who have seen it as being a model in all respects. It is located in a fine eucalyptus grove, which is right along the first section of road. The tents all have a raised wooden floor. They are equipped with iron cots and each man keeps his tent very clean.

The cook house is as clean as almost any home, being run by a man and his wife on salary. It is far ahead of the restaurants and hotels of that district.

Mr. Gaskill, who has personal charge of this contract, prides himself upon having a force of laborers all of whom are of known quality, having been with him for some time. He has provided a hot shower for the camp and has a splendid cooler for his provisions. This is loaded under his storage tank and has walls made of burlap. By having water drip upon this continuously and by the theory of evaporation, the provisions are practically in cold storage.

Four of the men have their families on the job, having their own tent houses. The contractors have also provided a large tent with a stove and benches which is used as a general loafing room by the men at night and days when they are not working.

Use of Six-Inch Side Rails

We are illustrating 6-inch side rails as used on back of curb and front of gutter by the Pietro Paving and Construction Co., Morgantown, W. Va., on 12 miles of street paving in 1915.

The same side rails which are used on sidewalk, curb, concrete road and combined base and curb construction are used on curb and gutter work.

The back face of the curb is formed by bolting any number

SHOWING TWO 6-INCH RAILS ON BACK OF CURB AND SINGLE 6-INCH RAIL FOR FRONT OF GUTTER. PIETRO PAVING AND CONSTRUCTION COMPANY, MORGANTOWN, W. VA., CONTRACTORS.

of side rails together, or by using a single rail of the required height. The front face of the curb can be formed by either a steel face rail or by a wood face rail. We recommend the use of steel face rails, as they are more quickly and easily handled than wood face rails and no clamps or bracing are required.

The front face of the gutter is formed by a Universal rail of the proper height. The expansion joints in the concrete are taken care of by dividing plates, which conform to the design required. These dividing plates are removed before the side rails and serve as templates by which to strike off and finish the curb and gutter. The side rails being slotted every 12 inches, expansion joints can be made wherever desired. The rails illustrated were furnished by the Blaw Steel Construction Co., Pittsburg, Pa.

Bitoslag Pavement

A new candidate for favor in the paving field is the bitoslag pavement, so named from the use of a specially prepared asphalt and crushed and pulverized slag in proper proportions in its manufacture. The first pavement was laid in McKeesport, Pa., in 1910, and the second in Germantown in 1915, and it is now considered to have demonstrated its success. The pavement is patented by J. C. Rock and is owned by the Bitoslag Paving Co., 90 West street, New York, who have issued a booklet describing the pavement and giving full specifications for all the materials and for the mixture and laying it on the road.

New Cement Plant at Duluth

The Duluth plant of the Universal Portland Cement Co. began operations February 15. Mill No. 7, as it is called, has four kilns, 150 feet long, with a daily capacity of 4,000 barrels. As in the case of other Universal mills, blast furnace slag and limestone are the raw materials. The plant adjoins that of the Minnesota Steel Co., which supplies the slag, and the limestone comes from Calcite, Mich.

All the grinding and burning machinery, elevators and conveyors are operated by individual motors and the same processes of manufacture are used as in the other mills of the company.

Power is furnished by the Great Northern Power Co. from its hydro-electric plant at Thompson, Minn., on the St. Louis river, 15 miles distant. Four thousand k.w. at 66,000 volts come to the power company's transformer at the plant, where the voltage is stepped down to 2,200. About half the current is used direct at this voltage, the other half being stepped down to 220 volts for the smaller motors.

The seventeen buildings are of reinforced concrete construction or of steel frame with curtain walls of concrete blocks. Floors and roofs are also of concrete. The storage tanks, twenty-seven in number, are of circular concrete design.

The plant employs between 300 and 400 men, for whose accommodation and also the employes of the Minnesota Steel Co., an industrial town, called Morgan Park, has been built near the plant. All the houses, streets, alleys, sidewalks, curbs and gutters in the town are of concrete. There are approximately 400 residences, including apartments and dwelling houses of such diversity of design that there is no suggestion of the monotonous uniformity usually prevailing in industrial towns.

A Keep-to-the-Right Standard

The Cutter traffic post has been designed to meet the demand for an attractive and efficient traffic signal. It is now in use in Chicago, St. Louis, South Bend and many other cities. The post is cast of the best quality gray iron from metal patterns, thus insuring clean castings, true to the ornamental design. The globe is made of light-density translucent glassware, ruby in color, combining high transmission qualities with good diffusion. With the high-candle-power lamp, the lighting unit can be seen at a distance under the worst of weather conditions and yet does not produce glare, thus meet-

CUTTER TRAFFIC POST MARKING CENTER OF INTERSECTING STREETS.

ing the most important requirements of an efficient signal. The base is 14 inches in diameter and 24 inches high. The column is 5 inches in diameter above the base, tapering to 3½ inches in diameter near the top. The height from the base plane to the bottom of the globe is 6 feet. The post has a 6-inch globe holder and is designed for 6 by 14-inch diffusing globes, but any globe with a 6-inch fitter can be used. These posts are made by the Geo. Cutter Co., South Bend, Ind.

Motor Trucks of America

The above sketch illustrates a Lee side-dumping truck body mounted on a Jeffery "Quad" chassis. This body dumps the load sideways. When the body is divided lengthwise into two compartments, half the load can be dumped to the left and half to the right of the truck.

This is only one of twenty-six devices equally as important, described and illustrated in an article entitled "Devices that Make for Motor Truck Efficiency," printed as an introduction to the 1916 edition (Volume IV) of "Motor Trucks of America."

This valuable hand-book, just off the press, is bigger and better than ever. All the principal motor trucks made in the United States are represented by photographs and tables of specifications covering all models. The specifications are arranged after a uniform plan, so that one truck can be readily compared with another.

This book is not for sale, but is published annually by The B. F. Goodrich Company for free distribution, not only to truck manufacturers, agents and salesmen, but to truck owners as well, and business firms contemplating the purchase of trucks. Requests should be written on business letterheads, and addressed to The B. F. Goodrich Company, Akron, O.

Road Surfacing

Road surfacing, as distinguished from applications of oil for dust laying, is covered in principle and practice in a booklet, "Trinidad Liquid Asphalt," just issued by the Barber Asphalt Paving Company, Philadelphia. The essentials of successful "carpet coating" with asphaltic materials are fully explained. As illustrations, the pamphlet contains photos of park drives, city boulevards, suburban streets and country roads resurfaced with liquid asphalt by both hot and cold applications. Full specifications, in the form of explicit directions for the laying of carpet coats, are included.

Blawform Bulletin 69

The Blaw Steel Construction Company, of Pittsburg, Pa., are mailing Bulletin 69, which contains twenty-eight pages of illustrations and descriptions of sidewalk, curb, curb and gutter and road forms; each form described is illustrated.

This bulletin also contains many large half-tone illustrations of forms as being placed by prominent contractor concerns thruout the country. Particular attention is called to the illustrations and descriptions of forms for combined base and curb construction, concrete curb construction, combined curb and gutter construction, sidewalk construction, etc.

Koehring Builds Low Price Mixer

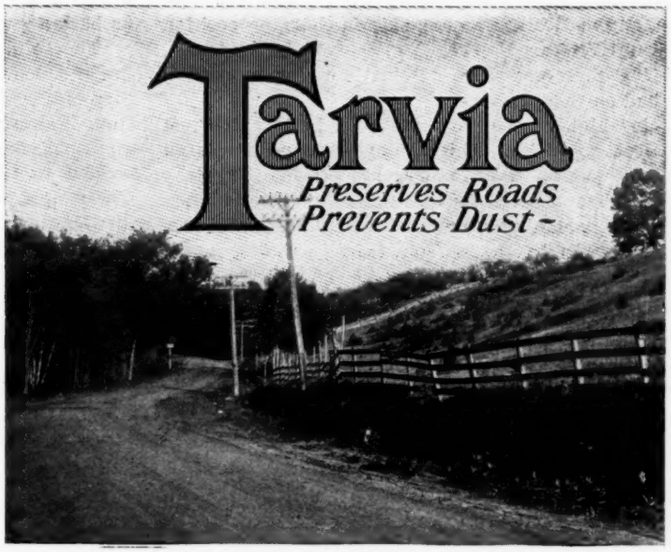
The Koehring Machine Company, Milwaukee, Wis., displayed two new mixers at the Chicago Show, which will be built in big volume on the "Ford" plan—fast manufacture of strictly standardized machines in big volume to make low price possible.

These mixers are called the "Dandie" line, consisting of construction-type mixers in 5 cubic feet and 10 cubic feet capacities, and a high-drum, end-loading paver, built in 10 cubic feet and 20 cubic feet capacities.

The Dandie construction-type mixer is a low-down mixer with platform for wheel-barrow charging, and may also be equipped with batch hopper and power loading-skip. The mixing action is the same as on regular Koehring mixers, with discharge spout extending inside the drum, and in mixing position forming part of the mixing section. This chute is reversed to discharge. The trucks are extra strong, and tires

How did *your* roads come through the winter?

ARE your macadam roads frost-proof? Are they in good condition this Spring? Or are you now going through a season of dirt and mud "while the frost is coming out". In a typical American township today are these examples of "spring" roads:



Note the clean, smooth, dustless Tarvia surface.

Case 1. Old plain macadam

Worn down by automobiles, exposing the uneven basic mosaic which has caught water and suffered severely from disruption by frost. Considerable loose stone. Mud now—dust later. No relief till warm weather when expensive resurfacing will be in order. Deterioration is 40%.

Case 2. New macadam last year

Still a good road but with a one-inch film of mud in wet weather and dust in dry. The smooth "roof" of the road is being destroyed. Already the road fails to shed water promptly, although the foundation is still intact. Deterioration 15%.

Case 3. Old macadam street treated with oil to suppress dust

Effect of the oiling has worn off. Plenty of dust now, or slimy black mud. Deterioration going on steadily because the oil had no bonding or dust-preventing power—it merely made the dust too heavy to blow. No relief in sight. After mud dries dust must blow till weather is warm enough for re-oiling. Can't even sprinkle with water on account of the old oil.

The foregoing represents the result of old and wasteful methods of road construction. We will now tell you of results where newer and more economical methods were used.

Case 4. Old macadam treated last year with a coat of "Tarvia-B"

Applied from a sprinkling cart, the Tarvia soaked into the surface forming a sort of tough tar-concrete. Sheds water like a duck. No mud or dust. No deterioration. Looks as good as it was last Fall. Needs only light renewals of "Tarvia-B" to make it better than ever.

Case 5. New macadam built with heavy "Tarvia-X"

Constructed layer by layer three years ago. The Tarvia cements the stone together in a traffic resisting layer. It added slightly to the original cost but saved much stone and labor. Clean, dry and smooth. It it shows any wear a light coat of "Tarvia-B" restores it to prime condition.

Tarvia makes macadam frost-proof, winter-proof and automobile-proof. It is a tough, dense, viscid binder, a plastic cement that defies water, weather and traffic.

Expense? Tarvia adds a little at the beginning and saves a lot in the end on the obvious principle that it is cheaper to have a road that will easily withstand modern traffic than to keep on renewing an inferior type of surface that is too weak for the traffic.

A road that pulverizes and abrades under the attrition of the backward kick of the automobile driving-wheels is an expensive nuisance nowadays. That is why the plain macadam road is disappearing.

Durable, dustless tarvia-bonded roads really cost less than dusty, water-bonded macadam roads owing to their longer life and lower maintenance costs.

There is a Tarvia process for most road problems.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by anyone interested.
If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

Illustrated booklet on request.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria
The Paterson Manufacturing Company, Limited:
Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

extra wide. All bearings are constructed on the universal principle. Double-drum drive-gears are cast from special composition metal. The power loading-skip has automatic knock-out and brake, automatically stopping skip in charging position and holding it until released.

The Koehring three-way-valve automatic water measuring tank may be had on these mixers.

The "Dandie" high-drum pavers are built in 10 cubic feet and 20 cubic feet capacities. This height of drum affords an unusually great spouting range, and makes possible the steep angle that causes fast flow of creamy concrete. The loading-skip accommodates two wheelers at the same time, and is provided with automatic knock-out and locks. The spout is self-compensating, maintaining the point of discharge at the same distance from the ground, regardless of how many sections are in use. The Dandie pavers are powered with gasoline engine, or with steam boiler and engine. Power plants on all Dandie mixers are securely housed. The Koehring Machine Company is distributing special literature on the Dandie line. Booklet E-33 on the low-charging mixer, and Booklet F-33 on the Dandie paver.

Kahn Portable Buildings

Kahn portable buildings have a wide range of usage and are to be had in units suitable for contractor and school purposes, as well as for hospitals, election booths, tool and material storage houses, etc.

Contractors, railroads and construction companies will find these units ideal buildings for offices, storage, bunk houses, etc. They are quickly erected and taken down and easily moved to the next job.

Being built of sectional units, they can be made in any sizes. The panels are interchangeable, so that the contractor can make his building either large or small, with practically any desired arrangement as regards doors, windows, etc.

The method of construction consists essentially of various pressed steel panels and units which can be assembled by anyone without special tools or equipment. By an ingenious but simple device, consisting of a slotted key and locking wedge, the entire building can be fastened together in an incredibly short time. No holes need be punched, no rivets driven, no bolts nor wire are used. An ordinary hammer is the only tool required. The various panels are of standard size and interchangeable, permitting buildings of any size or arrangement of wall space, windows and doors. The whole idea is as simple as building up a library with sectional bookcases.

The solid wall panels are manufactured from the highest grade of heavy-gage open-hearth steel and formed under large dies operated by powerful presses. All the operations of cutting, beading, punching, etc., are performed on specially designed machinery. The corners of the panels are electrically welded to assure maximum strength and weather-tightness. The simple paneling of the walls, while adding greatly to the strength, also presents a most pleasing appearance.

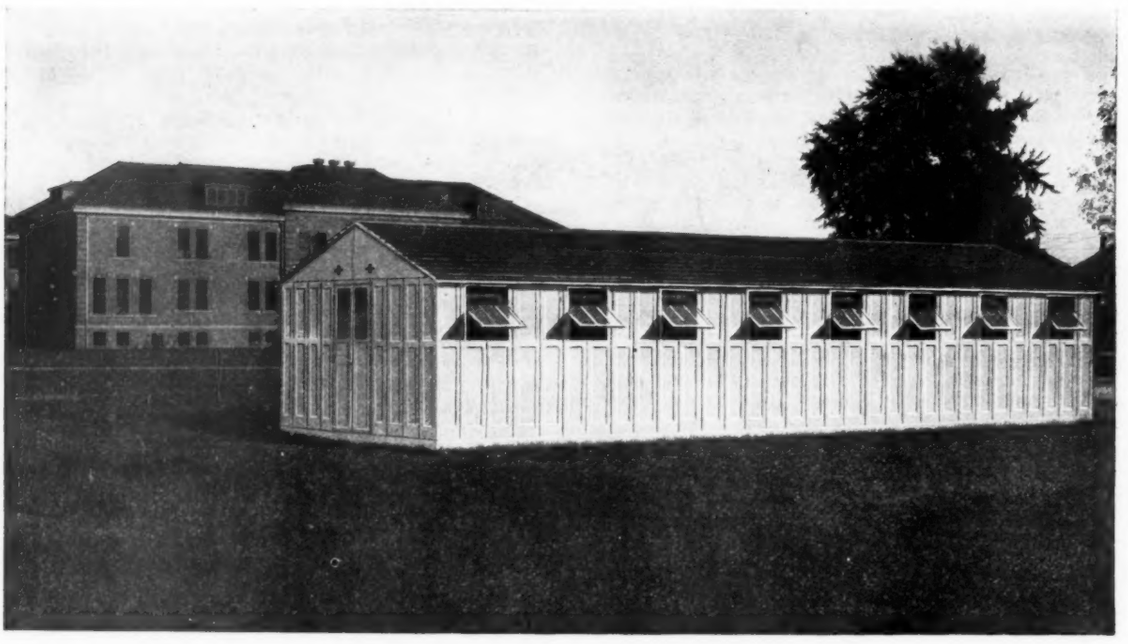
As for light and ventilation, these are provided for by the use of glazed panels which consist of steel sash welded into the standard wall panel. The sash is complete with pivoting and adjusting devices as well as all hardware. The center pivoted ventilator permits 100 per cent. ventilation, while the standard push bar and locking device allow wide variation in the adjustment of the ventilators.

These Kahn buildings are made by the Trussed Concrete Steel Co., Youngstown, O.

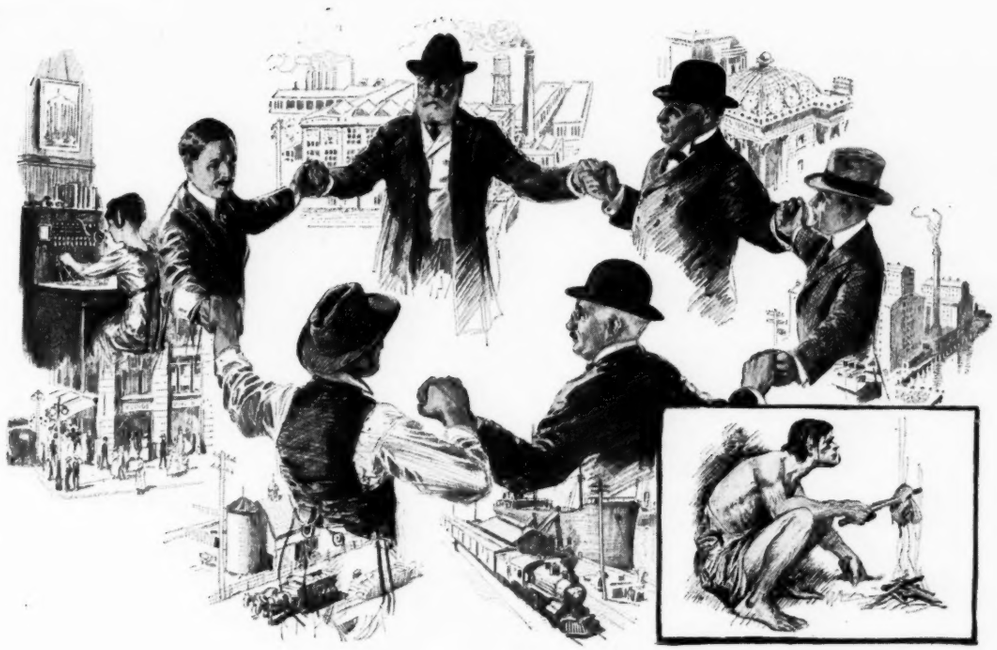
Brownhoist Drag-Line Excavator

The Brownhoist drag-line excavator can be used for digging canals and ditches, constructing levees, and for digging in certain kinds of ore. Due to the fact that such a large quantity of material is handled at a bucket load, this machine handles a large yardage in a day's time, at a low cost per yard. The booms vary in length up to 120 feet and the drag-line buckets vary in capacity up to 4 yards. Two men are required on the machine, one for operating and one for firing, while two to four men are needed on the ground, the number depending on the working conditions.

In digging canals and ditches the excavator works along the bank, digging the canal or ditch any width up to 100 feet and placing the spoil back from the bank any distance up to 120 feet. The machine can be equipped with skids or trucks, but the skids and rollers are generally used, as shown in one of the cuts. The machine is blocked while operating, and when it is necessary to advance, the blocks can be removed and, by placing the bucket in the ground, the machine will pull itself along the runway of heavy timbers.



KAHN PORTABLE BUILDING FOR VARIED PURPOSES.



Cave Life or Civilization

Civilized man is distinguished from the cave man by his habit of co-operation.

The cave man lived for and by himself; independent of others, but always in danger from natural laws.

To the extent that we assist one another, dividing up the tasks, we increase our capacity for production, and attain the advantages of civilization.

We may sometimes disregard our dependence on others. But suppose the farmer, for example, undertook to live strictly by his own efforts. He might eke out an existence, but it would not be a civilized existence nor would it satisfy him.

He needs better food and clothes and shelter and implements than he could provide unassisted. He requires a market for his surplus products, and the means of transportation and exchange.

He should not forget who makes his clothes, his shoes, his tools, his vehicles and his tableware, or who mines his metals, or who provides his pepper and salt, his books and papers, or who furnishes the ready means of transportation and exchange whereby his myriad wants are supplied.

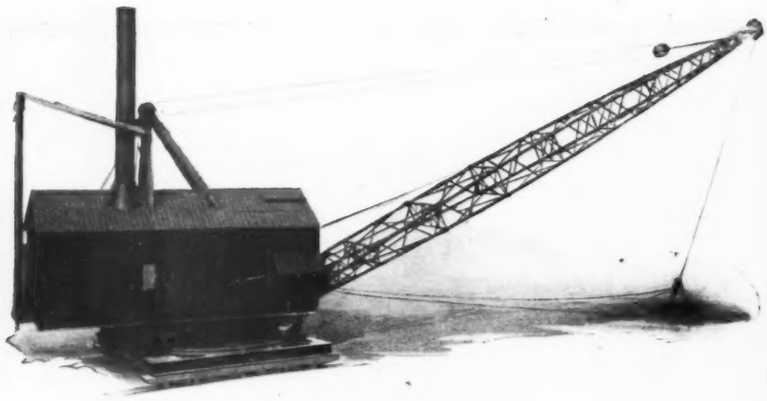
Neither should he forget that the more he assists others the more they can assist him.

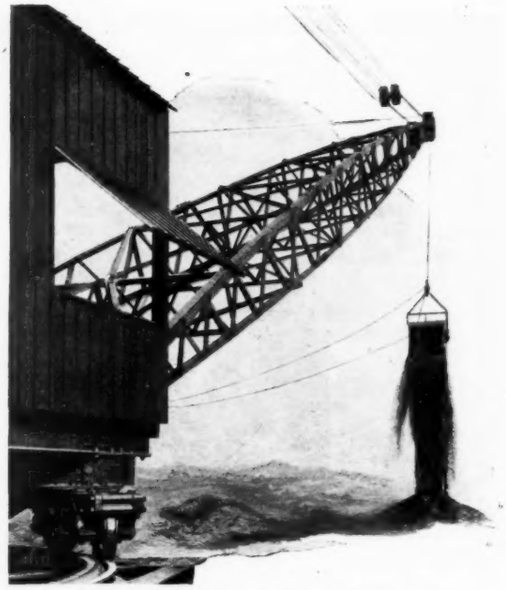
Take the telephone specialists of the Bell System: the more efficient they are, the more effectively the farmer and every other human factor of civilization can provide for their own needs and comforts.

Or take our government, entrusted with the task of regulating, controlling and protecting a hundred million people. It is to the advantage of everyone that the government shall be so efficient in its special task that all of us may perform our duties under the most favorable conditions. Interdependence means civilized existence.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*





DUMPING THE BUCKET WITH THE SPECIAL TRIP LINE.

"This type of excavator," states Mr. Melvin Pattison, general sales manager of the Brown Hoisting Machinery Co., "is built for speed as well as durability. It is equipped with a high-speed powerful engine, which is direct-connected thru Brown patented friction clutches, to the hoist and drag-line drums, and also to the rotating mechanism. The machine can be rotated in either direction simultaneously with the hoisting or lowering of the bucket.

"The circular track on which the wheels run is securely fastened to the rotating gear. This keeps the track and gear always in line, which results in easy operation at all times and in least wear on the rotating parts. The rotating gear is made to a large diameter, which gives a good mesh between the rotating pinion and gear.

"A large capacity boiler with feed water heater is used, so as to give ample power when the excavator is working at full capacity, and ample space is provided for coal.

"All clutches are operated by air furnished by a steam-operated air pump, which makes the operation very easy. The operator stands at the foot of the boom, where he has a good view of the work, and all levers and air valves for the clutches are within easy reach. The hoist-line runs from the drum to the head of the boom and to the bucket. The drag-line runs from its drum directly to the bucket, passing thru the two guiding sheaves located at the foot of the boom."

Fewer Truck Wheel Diameters Step Toward Lower Tire Prices

"Truck operators everywhere, we feel, can exert a marked influence toward the ultimate end of reduced solid tire prices," declares S. V. Norton, manager of truck tire sales for the B. F. Goodrich Company, Akron, Ohio, "by supporting the movement for a reduction in the number of standard S. A. E. wheel diameter sizes.

"Experience of all tire manufacturers, wheel builders and makers of steel rims," continues Mr. Norton, "has proved that unnecessary manufacturing costs can be eliminated thru universal adoption by truck makers of fewer wheel sizes than the number used at present. Instead of honoring specifications for six different wheel diameters, 32, 34, 36, 40 and 42, and these to be had in seven different widths, making forty-two different sizes, half this number is amply sufficient to answer the service demands of any form or make of commercial motor vehicles. With only three standard diameters, 34, 36 and 40 inches, to be provided, manufacturing and selling costs will be reduced, and the net result will prove greatly to the advantage of the ultimate consumer."

The Society of Automobile Engineers has already revised its original standards of 1911 to provide for only the three most practical and most-in-use diameters, viz., 34, 36 and 40 inches. A vigorous campaign is now on to influence all truck manufacturers to put into practice this recommendation for fewer diameters. At present 75 to 80 per cent. of all tires sold are 36 and 40-inch sizes. Probably 90 per cent. of the tires applied to newly-manufactured trucks are of these two diameters, while the 34-inch size is included to take care of trucks whoes design requires a smaller wheel.

"By simplified manufacturing processes," says Mr. Norton, "tire costs are bound to decrease in proportion as fewer molds and less special tire building machinery is required. Moreover it is far more economical in point of capital invested, for the manufacturer to stock only twelve or fourteen sizes, and decidedly more convenient, than to continue as at present keeping on hand from thirty to forty different sizes, in all distributing centers.

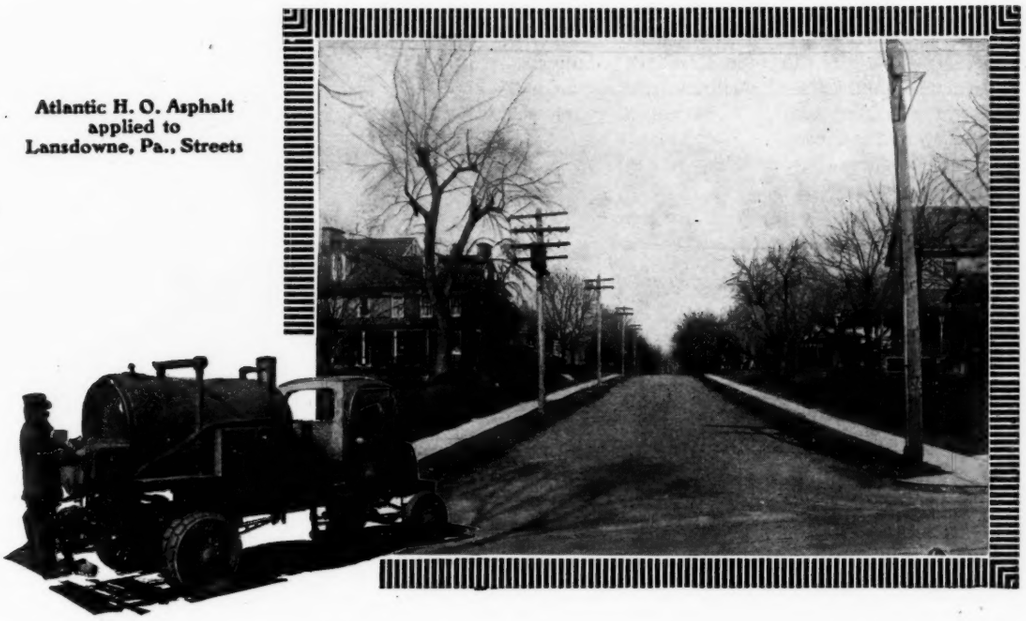
The Motor Truck and the Farmer

Before he bought his motor truck Edward Franzmeier got up at midnight and left at 1 a. m. arriving at the St. Paul market at 4 or 4:30 a. m. Now he rises at 4 a. m., starts at 4:15, arriving at the market at 5. He says that when the market is good he is often home again at 7 a. m. ready for a day's work. By the old method he was away from home from midnight until noon and came back with a tired team and himself in no condition to do very much work that day.

Mr. Franzmeier says he would not be without a truck and the Kissel Kar he bought suits him exactly. All of his farm hauling is done with it—such as hauling machinery or taking plows to the blacksmith, so that his horses are reserved for work in the fields.

Roughen Adjustable Paving Gage

We are illustrating the Roughen adjustable paving gage, which is adjustable to crown and width of pavement. This device is used either on top of a plain curb or on the gutter of a combined curb and gutter, and is easily moved along the street. The templates, two to each gage, made from selected timbers, are steel shod and fastened to the mast in the center of the gage and attached at the outer end to the steel extension plates. From 2 inches to 4 feet can easily be added to the length of any gage by drawing out the extension plates. On each side of the templates are trestle rods that hold the gage rigid, and extended from the top of the mast are the adjustable



Atlantic H. O. Asphalt applied to Lansdowne, Pa., Streets

Atlantic H. O. Asphalt

(Applied Hot)

Reduces Road-Maintenance Cost

This is the tried-and-true paving material that seals and waterproofs roads perfectly, producing a hard, tough surface that resists the incessant, abrasive onslaughts of traffic. Atlantic H. O. Asphalt is not a theoretical road-material—it is now and *has* been giving perfect service on mile after mile of urban and rural roads, under hardest conditions.

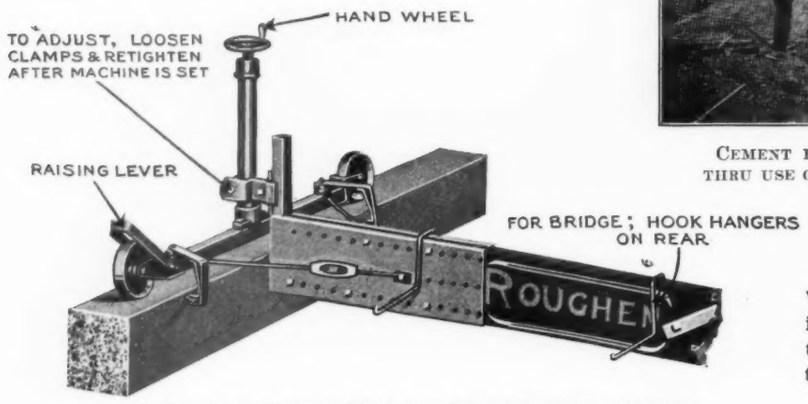
Atlantic H. O. Asphalt is Mexican asphalt, pure, tough and rubbery. It is heavy, waterproof and durable to a surprising degree. It gives best results when covered with finely crushed stone-chips or gravel. Applied by the Atlantic Refining Company's modern equipment operated by experienced men, under the exacting supervision of roadway experts. We will gladly furnish specific information as to quantities required, methods of application, etc.

The Atlantic Refining Company
Philadelphia Pittsburgh

rods provided with lock nuts to set and hold templates to the desired crown.

When the adjustment desired exceeds 4 feet, it is only necessary to procure new templates of such dimensions as will make the machine the desired width. These can be purchased from the manufacturer at low cost.

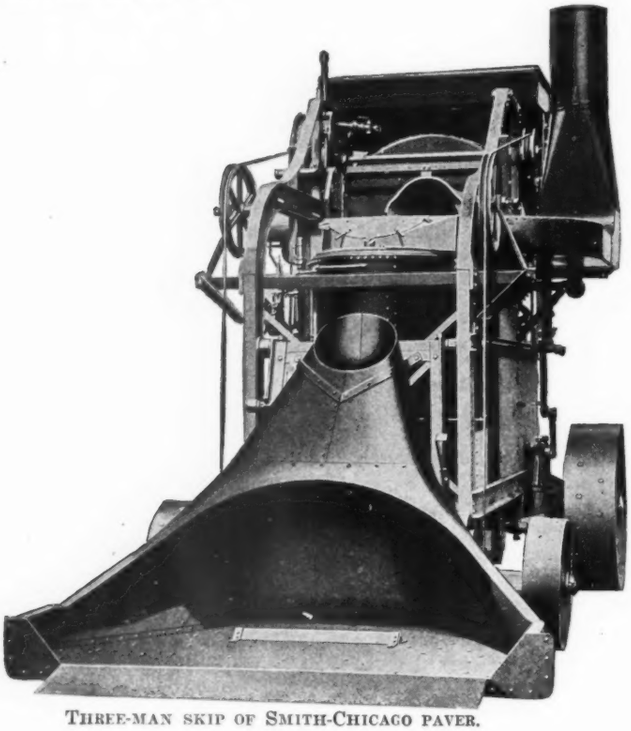
The sand should be spread by the gage to conform to the true curvature of the concrete base. The rounded, steel-faced


HAND WHEEL
TO ADJUST, LOOSEN CLAMPS & RETIGHTEN AFTER MACHINE IS SET
RAISING LEVER
FOR BRIDGE; HOOK HANGERS ON REAR
ROUGHEN

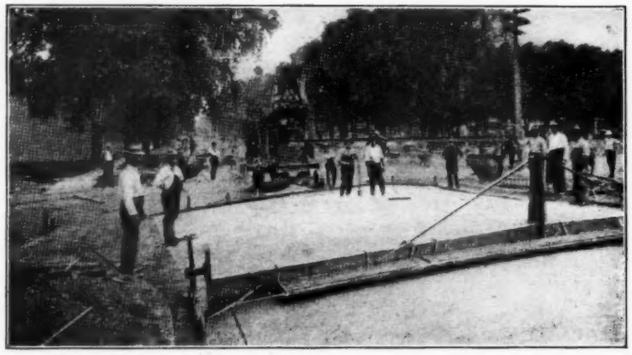
BACK VIEW SHOWING MACHINE SET FOR STRAIGHT CURB

edge of the template shoes, with the weight of the gage, if not alone sufficient, will at least greatly assist the compression of the cushion, which, together with the use of the hand roller, secures a sand cushion meeting the recommendations of the National Paving Brick Manufacturers' Association.

The gage is made into a bridge by tilting the levers up, so that the templates are raised about 1 inch above the work. A sufficient number of steel hangers are supplied with the machine so that a plank walk may be attached on the side of the gage. For finishing cement pavements, the bridge walk is ideal for finishers to work from, as the finishing progresses much faster and better and no board marks are left on the finished street. The machine may be used as a strike-off without removing bridge.



THREE-MAN SKIP OF SMITH-CHICAGO PAVER.



CEMENT PAVING AT LAKE MILLS, WIS., MADE PERFECT THRU USE OF ROUGHEN GAGE. ALSO USED AS A BRIDGE.

Trade Notes

The Badger Meter Mfg. Co., of Milwaukee, Wis., has been awarded the contract for furnishing the city of St. Paul. Minn., with water meters, from ⅝ inch to 1¼ inches, inclusive, for their 1916 requirements.

Mr. Dougherty, of the D. & D. Safety Cover Co., is making a trip from St. Paul to Boston, calling on city engineers on the way in the interest of his D. & D. safety cover for manholes and catchbasins.

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The offices of the Mexican Petroleum Corporation, Huasteca Petroleum Co., Petroleum Transport Co. and The Caloric Co., have been removed to 280 Equitable Building, 120 Broadway. New York.

Standard specifications for steel rails of the American Railway Association, the American Society for Testing Materials, and manufacturers of rails are collected in a booklet of Robert W. Hunt & Co., engineers, Chicago, Ill.

New Smith-Chicago Paver

One of the new features of the late model Smith-Chicago paver is a water-weighing device which measures each batch of water by weights.

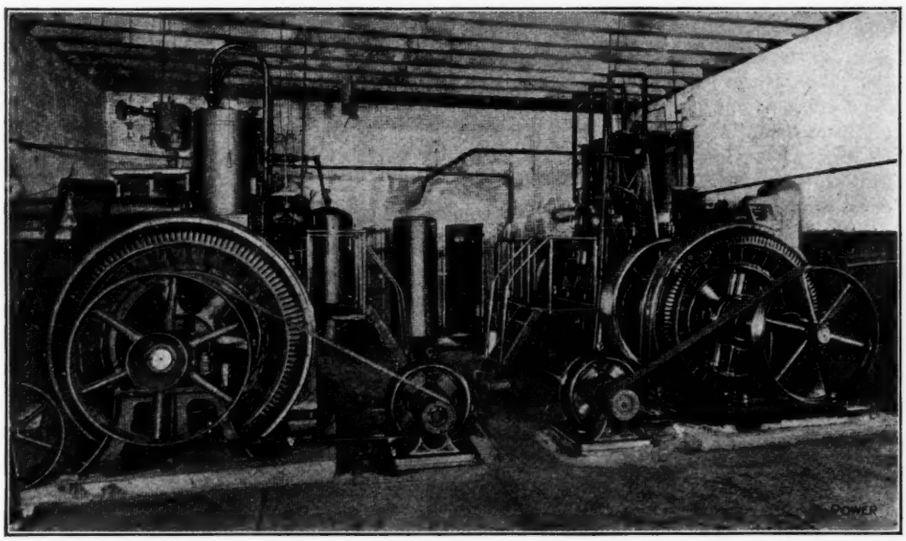
Another very important feature in this new machine is the long, steep chute. This chute is pitched at a 20-degree angle, so that even the stiffest concrete used for road work will easily slide down it. It is equipped with four intermediate discharge openings and an auxiliary swivel chute so that the concrete will not have to drop to the ground. With these four openings and the auxiliary chute a wide area can be concreted without moving the machine.

Another important feature is the fact that all the operating and driving gears are of steel and these are all carried on a large steel casting supported by the rear wheels. In this way there can be absolutely no chance for them to get out of alinement.

All sizes of this machine are equipped with powerful forward and reverse traction mechanism. The weight is all centrally located, so that there is no chance for the machine to be over-balanced.

The loading skip is made wide enough so that two or three barrows can be emptied into it simultaneously.

M & W Oil Engines



are paying off the debts

of Opelousas, Louisiana. For fifteen years the municipal water and lighting plant of this city of 5000 population was operated by steam power and just about paid expenses.

About six years ago the price of coal went up and the plant was operated at a loss until money enough for the engineers' wages was hard to get.

Finally, in desperation, the city government increased the tax rate, anticipated this revenue for two years and borrowed money for the purchase of a 100 hp. M & W OIL ENGINE, direct-connected to a 100 kva. alternator. They arranged to pay the balance due on account of the purchase of this engine and its auxiliaries out of the income from electric and water service, at the rate of $200 per month with interest.

This unit was so successful that another one of 150 hp. was soon installed. The city is now paying $450 per month towards the cost of the power plant, besides all labor and operating expenses —it is almost out of debt, and will soon have a surplus to apply towards the reduction of the tax rate. As compared with the steam power plant the two M & W engines

Save More Than Their First Cost Every Year

If your town is struggling under the handicap of the steam-driven pumping or lighting plant, get in touch with us and let our engineers look into your problem and tell you what savings M & W oil engines can effect for you.

AUGUST MIETZ MACHINE WORKS

131 MOTT STREET, NEW YORK.

71-11

Street Lighting in Detroit

The accompanying photograph shows one of the ornamental posts and lights used in Detroit in the municipal lighting system described on page 128 of this number of MUNICIPAL ENGINEERING. These ornamental posts are of the Broadway design manufactured by the George Cutter Company, of South Bend, Ind. They add materially to the artistic effect of the lights, and their daylight appearance is also very satisfactory. Heavy posts with large arms are so overpowering by day that the citizen is liable to forget the good effect of the lights at night because of the insistent size of the lamp supports by day, when they are constantly before him when he is on the street. No such complaint can be made of these posts.

Trade Publications

A "Bibliography of Municipal Government," by William Bennett Munro, Ph. D., LL. B., professor of municipal government in Harvard University, contains a classified list of the best materials available for study in every branch of municipal affairs. Particular attention is given to official reports, and to authoritative articles in scientific periodicals on such matters as water supply, sanitation, public lighting, street railways, and so forth. By far the largest part of the references are to publications which have appeared within the last twelve or fifteen years. Great care has been taken to arrange the materials s othat they may be easily found, and many of the citations have critical notes. An elaborate author-and-subject index is appended. It is published by the Harvard University Press ,Cambridge, Mass.. at $2.50. 472 pp.

"Municipal Charters" is a book by Nathan Matthews, LL. D., mayor of Boston from 1891-95, chairman Boston finance commission, 1907-09; lecturer on municipal government in Harvard University, of 219 pp. Published at $2 by Harvard University Press, Cambridge, Mass.

The annual report of the business and transactions of the president of the Boro of Manhattan, New York City, for 1914 has just been received. It gives the structure of the boro government, digests of the reports of heads of sub-divisions and full detailed reports from the Department of Public Works and the Bureau of Buildings. Marcus M. Marks, Boro President.

Bulletin 34U of the Chicago Pneumatic Tool Company gives instructions for installing and operating Chicago pneumatic Class N-SO fuel oil driven compressors.

The Roughen adjustable paving gage is described in a circular issued by P. Roughen, Fond du Lac, Wis.

Booklets A370 and A371 are two sections of a treatise on high explosives, issued by the E. I. duPont de Nemours Co., Wilmington. Del., the first section treating of their manufacture, handling, storage and use, and the second section giving in detail the kinds, grades and brands, with full statements of the important properties of each kind and the class of work to which each is particularly adapted.

Clifford Richardson, consulting asphalt engineer, New York, has written two papers on "The Theory of the Perfect Sheet Asphalt Pavement" and on "Trinidad and Bermudez Lake Asphalts and Their Use in Highway Construction," which have been reprinted by The Barber Asphalt Paving Company, Philadelphia, Pa., and copies can be obtained from them on request. "Good Pavements and How to Get Them" is the title of another handsome booklet issued by the company.

The advantages of Medusa waterproofed white portland cement are well stated in a booklet issued by the Sandusky Portland Cement Co., Cleveland, O., which is illustrated with views of many artistic and expensive structures in which the material has been used as a protection against deterioration on account of water, as well as for the artistic effect of the white cement.

Bulletin S 12 of the Ball Engine Company, Erie, Pa., illustrates the Erie revolving shovels.

Catalogs are issued by Crerar, Adams & Co., Chicago, Ill., of contractors' supplies on sale by them.

Scherzer rolling lift bridges, their inception, development and use, are well set forth in a fully illustrated booklet issued by the Scherzer Rolling Lift Bridge Co.. Chicago, Ill.

The Service Manual of the Service Motor Truck Co., Wabash, Ind., leaves little untold about the important details of this serviceable machine and the methods of operating them and keeping them in good condition.

A circular of the General Electric Co., on fundamentals of street lighting describes the use of holophane refractors on street lamps.

A pivoted bucket carrier for elevating and conveying coal, ashes, coke, stone, gravel, sand, etc., is described in Bulletin 17 of the Gifford-Wood Co., Hudson, N. Y.

A very convenient set of diagrams for computing the cost of pumping water under any practical conditions, covering the details of all steps in the process, is issued by the DeLaval Steam Turbine Co., Trenton, N. J., and will be sent by them on request.

Bulletin 84 on the Venturi meter will be sent on request by the Builders' Iron Foundry, Providence, R. I.

Hill's Cart and Wagon Works, Jersey City, N. J., make Hill's improved steel body spring pedestal balanced dumping truck, with canvas covers, to be used for making sanitary collection of refuse and garbage. The common sizes hold 3 and 4 cu. yds., but they are built both larger and smaller.

Bulletin S-14 of the Ball Engine Company, Erie, Pa., is a handsomely illustrated collection of facts, figures and photos of their Erie type B steam shovel.

The Gramm-Bernstein Company, Lima, O., demonstrate the capabilities of their trucks in a booklet entitled "The World's Best in Motor Trucks."

"Conservation by Preservation" is the subject of a booklet on wood preservation issued by the C-A-Wood-Preserver Company, St. Louis, Mo.

The United States Asphalt Refining Company, of New York and Baltimore, issue a paper by Leroy M. Law, their chief chemist, which, under the title, "The Merits of Refined Asphalt Roads," gives details of the various kinds of asphalt derived from asphaltic oils, with special attention given to Mexican asphalts, showing the reasons for excellence and adaptability of these products.

The Hurst Silo Equipment Company, 819 Exchange street, Chicago, Ill., publish a catalog of Hurst gravity mass block, molds, rod and plate cutters and benders, door frame patterns, steps, etc.

The Whalen Form, Syracuse, N. Y., publish an illustrated circular giving details of their forms and photographs of installations and of culverts built with them.